# ENGINEERING NEWS

WE have made due enquiry about the Philadelphia brick-subways reported as being actually started. We find that while wires are being buried in every direction there, in wood and iron conduits, no brick-subways are under construction; and further that there is no authority as yet, either asked for or obtained, for such subways. We would suggest to our contemporaries that in the words of the late JOSH BILLINGS: "It is better not to know so many things than to know so many things that are not so." But we are sorry; for we had hoped that one American city was at last about to display some superior wisdom in the disposal of its electric wires and adopt a method that we have long advocated as an advance upon present slip-shod practice

A CROSSING WAR of large dimensions has started in Manitoba. The No'n Pac. & Manitoba Ry., with the support of the government and people of the Province is endeavoring to force a crossing over the Canadian Pacific tracks. The Canadian Pacific Railway with the sympathy and support of the Dominion officials is endeavoring to oppose it. Each side has a large force of armed men on the ground with all the other disgraceful accompaniments of these crossing wars which break out from time to time—to teach railway employes respect for law and order, we suppose. Feeling runs very high in Manitoba, and appears to be strongly in favor of the Northern Pacific, but the details of the quarrel are not so fully given as to "tell us all about the war, and what they killed each other for," by any means.

THE cost of electric light in Pawtucket, R. I., and other cities is given as follows in Mayor GOODWIN'S message of Oct. 16, criticising the report of a committee. The Pawtucket Gas Co. will furnish 152 lights burning until 1 A. M. for 37½ cts. per night, or $136.87½ per year each: and it will let them burn until daylight for $182.50 each per year. The committee presented the following table of the cost of electric street lighting in various cities, per light per year all night:— Baltimore, $255; Boston, $237.50; Buffalo, $200.75; Philadelphia, $200.75; Evansville, Ind., $200: Davenport, Ia., $190; Pittsburg, $200; Detroit, $187; Albany, 182.50; Providence, $182.50; Grand Rapids, Mich., $173; Cleveland, $172.50; Rochester, N. Y., $164.25. In the following named places the lights burn only until midnight; Fort Wayne, Ind., $135; New Orleans, $145. The committee recommended that the city establish as soon as possible an electric light plant of its own; they estimate the cost of such a plant for Pawtucket at $70,000. This plant would furnish 360 lights of 2,000 candle-power. The Mayor objects to this proposition on the grounds of incompleteness, as the price given did not include cost of land, buildings or engine, and he has also doubts as to the wisdom of the city owning and operating its own plant.

WE have a letter for our late correspondent "Alpha," of Kansas City, Mo., if he will send his address (which has been mislaid,) to this office.

THE iron caisson for the lake crib of the Chicago water works tunnel is stuck in the sandy bottom of the lake near the shore. Mr. ARTINGSTALL, the ex-City Engineer is in charge of the case and is planning as to the best means of lifting it and sending it on its way lakewards.

THE first span of the Hawkesbury bridge, in New South Wales, recently erected, is stated to be 416 ft. long and weighs 800 tons. It was built on a pontoon 315 ft. long, 60 ft. wide and 12 ft. deep, cut into 44 compartments and covered with galvanized iron plates. On this was a falsework 50 ft. high on which the span was erected. Several tugs took the pontoon and span out to the site, between Piers 3 and 4, and, by taking advantage of the tide, the span was safely seated. All of the piers are now completed and the spans will all be erected within the next two months.

THE CHIGNECTO ship railway seems now to be an assured fact. Mr. H. G. C. KETCHUM, of Fredericton, N. B., the Resident Chief Engineer and original projector of the work, has returned to this city with a full staff of engineers, under whom the work will immediately begin. Further details are given in another column.

THE Port Huron Tunnel Company has purchased 36 lots in Sarnia at a cost of $9,500, and work will be resumed at once. The first proceeding will be to open a cut or "hopper" directly over the site of the portal, 200 ft. wide on the surface, and sloping to 30 ft. square at the bottom. The bottom will be on the grade of the tunnel, which will make the depth of the "hopper" on the Canadian side 60 ft., and on the Michigan side 45 ft. The boring machinery will be placed in position at the bottom of the pit, and the work of construction begun from each end and carried to a junction under the middle of the St. Clair. The excavation will be done by contract, which has been already awarded, and calls for the completion of the excavation in three months. About 50,000 cu. yds. of earth will have to be moved.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment on Oct. 19 of the Baltimore & Ohio express from Cincinnati at Washington, Pa. The train passed over the long trestle west of the city at high speed, and was derailed at an open switch leading to a Y. The engine, tender, baggage car, freight car, sleeper and 2 passenger cars went over the trestle, about 12 ft. high at that point. Two men were killed and about 20 injured, some seriously. The responsibility for the accident has not yet been settled. In one of the passenger cars the stove was overturned and set fire to the car, which was extinguished by water from the cooler. ——A similar accident, but one in which no loss of life resulted, occurred Oct. 21 to an excursion train on the Elmira, Cortland & Northern near Breesport, N. Y.; the train was derailed at a misplaced switch and the engine and baggage car went into the creek.——A serious accident, derailment and collision combined, occurred Oct. 23 on the Pennsylvania road near Tyrone, Pa. Two freight trains were passing when the engine of the east bound train jumped the track and ran into the West bound train; 22 cars were wrecked and thrown over the bank. Two persons were killed.——A serious rear collision on the Erie, causing 1 death and 8 injuries resulted from the breaking in two of a long freight train near the top of a long grade.

BOILER EXPLOSION. On Oct. 33 the boiler of engine No. 430, on the Mine Hill branch of the Philadelphia & Reading, running between Cressona and the head of Gordon plane, exploded near Glen Carbon, Pa., killing two men and injuring two more. The accident is attributed to low water in the boiler.

BRIDGE ACCIDENTS are reported as follows: On Oct. 18, sparks from a freight engine set fire to the bridge at Wray, Col., and it was completely destroyed. A temporary trestle has been erected and traffic is not much interfered with.——On Oct. 22 the Chicago, Burlington & Quincy bridge near Sterling, Ill., was destroyed by fire. It was 100 ft. long, and was built 5 years ago at a cost of $20,000.

A TERRIFIC LANDSLIDE, overwhelming a train, occured at Potenza, Italy, Oct. 18. Ten cars of a train, crowded with excursionists returning from the Naples fetês, were crushed, the landslide consisting of somewhere between 50,000 and 200,000 cu.m.of rock, according to the varying accounts. The scene that followed the disaster was horrible, 70 injured passengers and 90 corpses were soon taken from the wreck and the total deaths were probably fully 150, as two entire cars were completely buried and inaccessible. The train had 400 passengers in all. The accident was not a collision with a land slide, but an encounter with one from above in the act of falling.

THE CUMBERLAND RIVER improvements have been begun by starting work on the first of the series of 23 locks and dams, averaging 15 ft. apart, which will be required between Nashville and Point Burnside. The locks are 52 by 280 ft. The dam is of crib-work, about 400 ft. long.

THE PANAMA CANAL is to be opened in July, 1890. At a meeting at Lyons, Oct. 21, M. DE LESSEPS declared this fact positively and said he wished to correct the painfully inaccurate report that the opening would be delayed until 1891. M. DE LESSEPS is now engaged in trying to dispose of more securities and evidently sticks at nothing to help in this end.

THE late strike of workmen on the Eiffel Tower in Paris was due to the fact that they were compelled to crawl down and up 500 ft. of ladders to get their dinners, thus consuming the most of the time alloted them for mid-day rest. A restaurant on top of the tower settled the trouble.

THE public baths at Pesth are said to be supplied with hot water by an artesian well now 8,140 deep. This well furnishes 176,000 galls. daily at a temperature of 158° *F.* The same contemporary stating the above, further says that the authorities have determined to go deeper with the intention of obtaining more water and a temperature of 176° *F.*

THE Baltimore & Ohio is fitting up 20 cars with the Johnson electric heat regulating device, and will equip 55 cars at once. Last fall a single car on this road was thus equipped, and has, it is stated, given entire satisfaction.

A GREAT reservoir dam on the head waters of Kern river in California, is about to be built by JAMES D. SCHUYLER, the engineer of the great Sweetwater dam, near San Diego, as noticed in our correspondence from him published Sept. 22. The dam will be 250 ft. high, constructed by running drifts into the big cliffs that form the walls of a deep gorge, filling the drifts with heavy charges of giant powder, and tumbling the whole side of a mountain into the gorge at a single shot. Above the gorge is a large, level valley, which is the basin of an extinct lake. By filling the gorge, this will again become a lake, and will constitute, it is said, the largest storage reservoir in the world. In the same region other immense reservoirs will be made in the same way. They will be filled by streams flowing from Mt. Whitney and other large mountains in the same neighborhood. The water stored in these reservoirs will be used on ranches in the San Joaquin valley. Lakes that have not yet been drained can be utilized in the same way. The gates for drawing off the water of the reservoirs will be placed in tunnels driven through the solid rock, forming the jaws or side walls of the gorges.

THE drainage of land in England was lately treated in a paper by Mr. R. B. GRANTHAM read before the Institution of Surveyors. The author described the drainage of 3,600 acres of land in South Lincolnshire. The cost of laying the under drains varied from $18.58 to $26.90 per acre on the fen lands with pipes laid from 2½ to 3 ft. deep; and on the marsh land from $28.05 to $13.70 per acre. The system pursued was to divide the fields into plots of 20 or 30 acres by cutting open ditches 5 ft. deep discharging into the main outfalls. The outlets of the main pipe drains were laid 3½ ft. below the surface on the marsh land and from 2½ to 3 ft. on the fen lands; the main pipes were nearly level. The minor drains were laid at an inclination of not more than 1 in 1,600, the minimum depth being 2 ft. The pipes were laid from 36 to 60 ft. apart according to the stiffness of the soil. In this connection it might be mentioned that F. N. Spon & Co. announce a new work on "The Drainage of Fens and Lowlands by Gravitation and Steam Power", by W. H. WHEELER, M. Inst. C. E., which is commended as entering fully into the class of details usually sought for by the engineer interested in drainage projects.

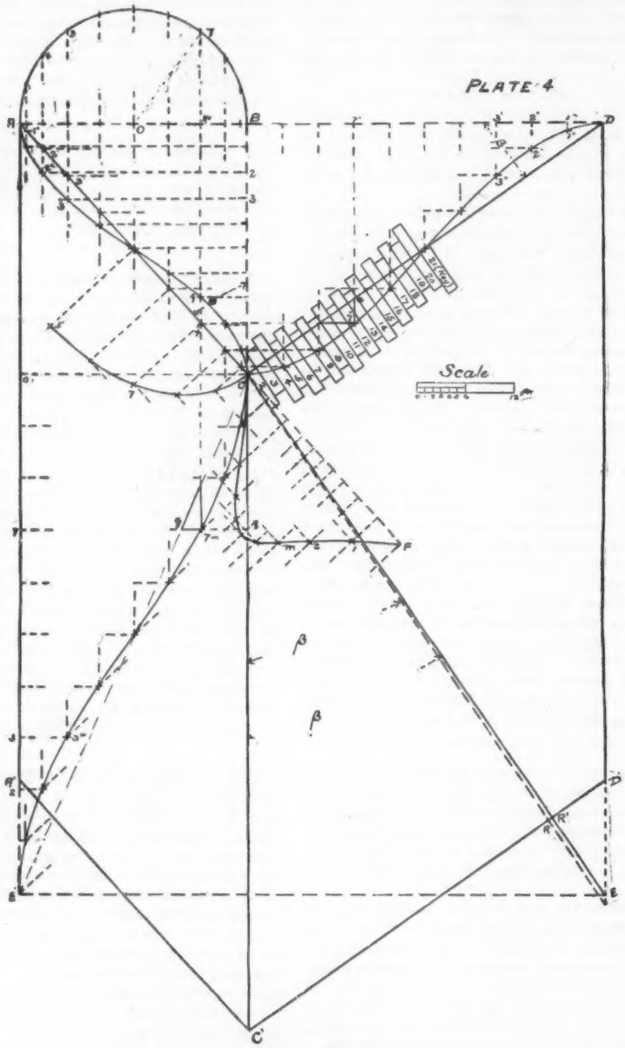
THE latest information as to the Cairo bridge across the Ohio river, is to the effect that the 13 main piers, excepting one, are completed in their foundations, with the masonry finished on 5 piers. The superstructure will be made up of 7—400 ft., 2—520 ft. and 3—250 ft. spans, with nearly 1,000 ft. of approaches on each side. Of the superstructure, the two 250 ft. and one 520 ft. spans are swung, and the false works are up for the second 520 ft. span. The foundations were put in by the firm of ANDERSON & BARR, of New York; the masonry by L. M. LOSS, of Rochester, N. Y., and the entire structure is under contract with the Union Bridge Co., of New York. The deepest foundations are 75 ft. below low water mark, but the greatest depth below the water surface of any foundation was 94 ft. Compressed air was used throughout.

## The Construction of a Skew or Spiral Arch.

BY M. P. PARET, DIV. ENG. C. & R. R. R. *

(*Continued from page* 301.)

We now come to the development of the arch, by which is obtained the dimensions of the impost quoin and ring stones. The arch is full centered with a span of 28 ft. at the springing line; the length on the skew, 80 ft. and 2-in., is apparently extreme, but by agreement with the C., W. & B. R. R. Company it was built to allow for a proposed raise in their present grade of 11 ft.



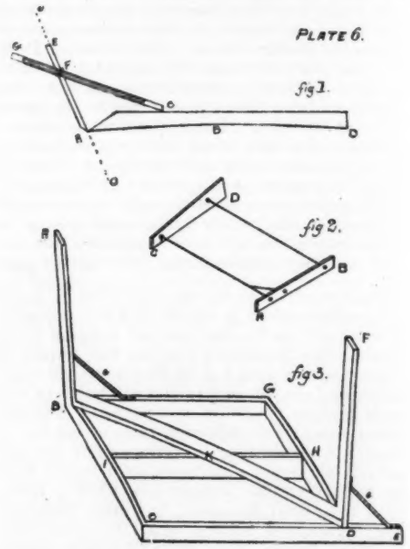

Development of a Spiral Arch.

Plate No. 4, shows the development of the arch and obtaining of the coursing and heading spirals. Referring to this plate, $A\ C\ C'\ A'$ is plan of arch at springing line, $A\ A' = 80$ ft. 2 ins. $A\ C = 41.44$ ft. the skew span. $A\ B = 28$ ft. $OA$, the radius, = 14 ft., $A\ C\ B$ = the angle of obliquity = $\phi = 42° 30'$.

To obtain a heading spiral, with $C\ C'$ as an axis, develop the intrados or soffit. $A$ will fall at $D$, $A'$ at $D'$, $B\ D$ being equal to 43.98 ft. or the semi-circumference of a circle of 14 ft. radius. By calculation $B\ C = 30.55$ ft., then in triangle $B\ C\ D$ by calculation the angle at $D = \beta = 34° 47' 22''$; this is called the angle of the intrados and is the angle made by the intersection of a coursing spiral with the axis of the arch, in development.

Join $C\ D$, draw $C\ E$ perpendicular to it, $C\ E$ is then the direction of an intradosal coursing joint, and the angle $E\ C\ C' = \beta$. With $O$ as a center, describe the semi-circle on $A\ B$, divide this into a number of equal parts 1, 2, 3, also divide $B\ C$ into the same number of equal parts; the corresponding points projected to an intersection will form the heading spiral $A\ 3'''\ 7'''\ C$. By laying off the distance $B\ C$ along the springing line $C\ C'$, a heading spiral can be obtained at any desired point. Now if the development be rolled back again, $E$ will fall at $E'$, which will be the other extremity of the coursing spiral through $C$. Project $C$ across to $c$, divide $c\ E'$ into the same number of equal parts as was the semi-circle, project corresponding points to an intersection, and we have the coursing spiral $C\ 7'''\ 3'''$, $E'$. To obtain a mould with which to draw the coursing joints as shown on Plate No. 3, extend the line $E'\ 1''''$, $2''''$, $3''''$, etc., let fall perpendiculars, and on these lay off from $C\ F$ the corresponding sines measured from $A\ B$ to 1, 2, 3, etc. Joining the points so found gives the curve desired $F\ 1\ m\ C$. In a similar manner is found the curve $C\ 7\ r\ 5$, which gives a mould with which to draw the heading spirals on Plate No. 3.

The face of the arch being made by a vertical plane passed through the ends of the springing line, the face end of the ring stones will not follow a heading spiral on the soffit. This vertical plane cuts the soffit in an ellipse shown by the straight line $A\ C$, or in development by the spiral $C\ 7''\ 3''\ D$. If we divide $C\ D$ into an odd number of equal parts, we obtain the number and thickness of the ring stones. (Divide $C'\ D'$ similarly, then if $C\ E$ does not intersect $C'\ D'$ at one of these points of division, it must be made to do so, and an adjustment made in the intradosal angle. In this arch the nearest point of division is 5 9-16-in. from $R$ toward $C'$ and the adjusted angle $\beta' = 34° 23' 06''$. As the arch was turned with brick, and a coursing spiral could not have been farther away than ¼ a course of brick, the adjusted angle was not used. It would be necessary to use it, however, in an arch all stone. Through these points of division draw lines parallel to $C\ E$, lay off the greatest length desired for the longer side of the short stones on $C\ E$, through this point draw a spiral parallel to $C\ 7''\ 3''\ D$, this will give in plan the length of the short stones, square off the back ends and make the longer stones the desired length; in this case 4½ ft. $C\ D = 53.54$ ft; this divided by 39 gave us 16 7-16 ins. as the width of each of the 39 ring stones, and conforming with the thickness of six courses of brick on edge. Facing the arch the acute quoin stone on the left is numbered 1, the first ring stone 2, and so on over the arch to the right, the key being 21. The quoin stones 1 and 41 form the skew-backs, from which spring the adjacent ring stones. Ring stone 40 and the quoin stone 41 were made in one stone. A pattern house was built 28 × 20 ft. inside, the floor being tongued and grooved and planed. On this was laid off to full size the development of the semi-ellipse or ¼ the spiral $C\ 7''\ 3''\ D$, Plate 4; this was done by means of




Shifting Stock for Drafting Spiral Arch.

ordinates found thus: draw $O7$, connect 7 and 7°, cutting $A\ B$ at $p$, then $Op = O7 \cos p07$. $07 = R = 14$ ft., $pO7 = 3·5\ (90°) = 54°$, then $Ap \cot \phi = p7° = 7'\ 7''$. But $7'\ n = 7'\ D \tan g\ \beta$. $7'\ 7'' - 7'\ n = n\ 7''$, the ordinate sought, which is laid off on a line making an angle with $C\ D$ which is the complement of $\beta$. The distance to the foot of this ordinate $= C\ n = \dfrac{B7'}{\cos \beta}$.

As before described the width and length of the ring stones were laid off and patterns so obtained are for the soffit.

Next, to obtain the face patterns, full sized semi-ellipses or a section of the arch parallel to the face, showing intrados and extrados were laid out on the floor.

The ordinates of the ellipses are readily calculated from the relation the axes bear to each other. To fix the position of the face joints, the full-sized soffit patterns were applied to the intradosal ellipse in proper succession; see Plate No. 7, Fig. 1. $A\ m\ n\ D$; the sum of the width of these patterns, measured along the curved ends, must equal the circumference of the ellipse as the spiral $C\ 7''\ 3''\ D$ (Plate No. 4) from which they are obtained: this is but the development of the ellipse as before shown.

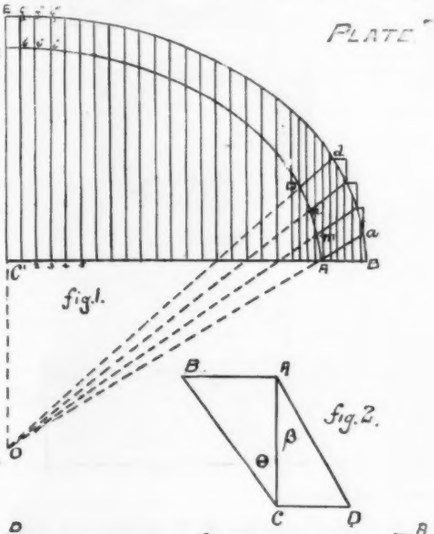
The joints as they appear on the face are not straight lines, but nearly so and may be so taken. These joint do not radiate from the center of the semi-circle, but from a point $O$ directly below, see Plate No. 7, Fig. 1. This point $O$ is called the center of eccentricity, and is obtained by calculation, or more easily geometrically as follows: see Plate No. 7, Fig. 2. Make $A\ B = 16$ ft. 2 ins., draw $A\ C$ perpendicular to it, making the angle $A\ C\ B = \phi$ and draw $C\ D$ perpendicular to $A\ C$, making the angle $C\ A\ D = \beta$; then in Plate No. 7, Fig. 1, extend $E\ C$ to $O$, making $C\ O = C\ D$, Fig. 2. $O$ is then the center of eccentricity, in this case equal to 12.27 ft. From $O$ draw lines through the division $A\ m\ n$, etc., and the

*Reprinted from the *Journal of the Engineering Society of Lehigh University* Vol. III. No. 2.

joints are obtained, from the ends of which at the extrados draw plumb and level lines, and the face patterns are finished. The point of eccentricity fell outside of our pattern house, but a narrow door built the full length of the house, when raised, enabled us to stretch a line from *O* to any point on the face.

To obtain the bed patterns or practically the angle which the face joint makes with a line joining the ends of the stone on the intrados, (which angle varies according to the length of the stone, see Plate No. 7, Fig. 7, and with the height of the joint above the springing line,) there are several methods given by the authorities; by calculation, by means of diagrams, by construction from the full-sized face development, etc.

The method used in the construction of this arch was so far as we know original with it. A shifting stock was made, see Plate No. 6, Fig. 1, all the pieces of half-inch hard wood. *A D* 7 ft. long, and 3 ins. to 4 ins. wide, *A E* 3 ft. long, 1¼




Spiral Arch Patterns.

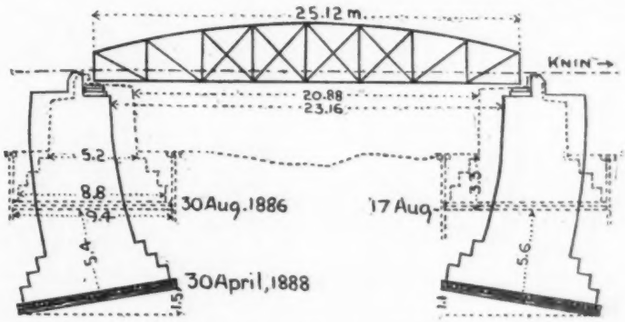
ins. wide, *A B D* is cut to a curve to fit the soffit arris or the curve made by the intersection of the warped surface of the bed with the warped surface of the soffit. The obtaining of this curve will be explained later. The arm *A E* is hinged to *A B* at *A*, the point of the hinge being both on the curve *A B D* and straight line *O E*, *C G* is hinged to *A B* at *C* and has a long slot in it, through which passes a clamp *F*, which is countersunk into *A E* to allow the stock to be laid flat on the stone. The clamp screw can be taken out and the arm *C G* put either side of *A E*.

It is evident *A E* can be clamped anywhere within the limits of the slot, which was made long enough to cover the scope of the angles required. As soon as the lagging was all placed on the ribs, the face line was marked over it with the transit from reference points and the soffit patterns laid side by side over the lagging, the points where the joints came along the face being marked and referenced by oss lines; auger holes were bored through the lagging in the approximate direction the joint would take. The excavation was deep enough to drive a nail in a stout stake at the center of eccentricity; a cord made fast to the nail and passed up through the auger holes and the intersection of the reference lines gave the true direction of the face joints. The shifting stock was set on the lagging *A B* along the coursing spiral, and *A E* clamped in position to just coincide with the line of the cord *O e* as shown. As soon as it was clamped the angle was transferred to paper and a record kept. In using the shifting stock the factor of length of stone did not appear.

(TO BE CONTINUED).

## Building up on a Sinking Foundation.

The *Wochenschrift des Ingenieur und Architecten-Vereins*, gives a sketch (here reproduced) showing the settling of the abutments of the Orazinica Bridge near Knin, Austria. The dotted outlines show the original abutments as standing at the end of August, 1886; the full lines show their position at the end of April, 1888. It will be seen that, in that time (20 months) the abutments sank nearly 20 ft. The bridge was not abandoned for this cause, but was kept at the proper grade by means of wooden beams, which were from time to time replaced by masonry, until on the Knin side,




A Case of Settling Abutments. (Dimensions in Metres.)

950 tons of material had been added to the original abutment. A proper foundation has apparently been at last reached, for the settlement has now ceased.

## Accidents to English Railway Employees.

The returns of the Board of Trade make the following highly creditable showing of the decrease in deaths and injuries of railway employés in recent years.

| | By train accidents. | | Other accidents on railways. | | Accidents to number employed. | |
|---|---|---|---|---|---|---|
| Year. | Killed. | Injured. | Killed. | Injured. | Killed. | I'jured. |
| 1874 .... | 46 | 271 | 742 | 2,544 | 1 in 320 | 1 in 89 |
| 1875 ..... | 21 | 239 | 744 | 3,379 | 1 " 334 | 1 " 70 |
| 1876. .... | 28 | 236 | 645 | 2,364 | 1 " 366 | 1 " 100 |
| 1877..... | 22 | 154 | 630 | 2,009 | 1 " 414 | 1 " 123 |
| 1878..... | 15 | 156 | 529 | 1,847 | 1 " 500 | 1 " 135 |
| 1879..... | 8 | 118 | 444 | 1,836 | 1 " 619 | 1 " 143 |
| 1880... . | 24 | 118 | 523 | 1,902 | 1 " 531 | 1 " 139 |
| 1881..... | 19 | 108 | 502 | 2,378 | 1 " 576 | 1 " 123 |
| 1882..... | 21 | 153 | 532 | 2,423 | 1 " 570 | 1 " 122 |
| 1883..... | 11 | 87 | 543 | 2,373 | 1 " 596 | 1 " 134 |
| 1884..... | 23 | 115 | 523 | 2,204 | 1 " 634 | 1 " 149 |
| 1885..... | 13 | 81 | 438 | 2,006 | 1 " 768 | 1 " 163 |
| 1886..... | 4 | 81 | 421 | 1,929 | 1 " 815 | 1 " 172 |
| 1887..... | 8 | 109 | 414 | 1,966 | 1 " 821 | 1 " 167 |

The total number of employés was 250,000 in 1874 and 346,426 in 1884, which is supposed to be not far below the number now. Subdivided by causes we have for 1887

| | Killed. | Injured. |
|---|---|---|
| Coupling cars | 26 | 232 |
| Shunting and yard work | 89 | 920 |
| Caught between cars | 9 | 55 |
| Falling between train and platform | 5 | 33 |
| Walking on track | 99 | 97 |
| do. on duty | 93 | 127 |
| Total for these causes | 321 | 1,464 |
| Other miscellaneous causes | 93 | 503 |
| Train accidents | 8 | 109 |

The insignificant part which train accidents play as a cause of injury is very striking. The number of casualties from coupling cars has decreased somewhat, having been 44 killed and 313 injured in 1878.

Similar statistics do not exist for this country, as a whole, although they do for various States. How a comparison would stand cannot be determined without more labor than we can now undertake.

## The New Chicago Tunnel Caisson.

After several fruitless efforts on the part of the contractors to move the iron caisson for the new tunnel in its present form into the place designed for it two miles out in Lake Michigan, the city engineers and contractor ONDERDONK have come to the conclusion that the best course to pursue is to raise the structure to an upright position, put in a bottom after the manner of a barrel, or tub, and float it with the assistance of scows to the place of destination. The plan that the caisson should be floated by means of derricks on scows and pushed through the water was a manifest impossibility even in calm weather. The surface of half the circumference of the caisson was opposed to the resistance of the water. The movement of the caisson would be quite slow—so slow that the journey would far exceed any continuance of calm weather likely to occur in this latitude at this time of the year. According to the new plan a floating surface of over 2,000 sq. ft. will be presented to the water instead of the cutting edge of the caisson, as under the old scheme. It is proposed to place the bottom about 3 ft. above the base. The engineers calculate that the weight of the structure, about 300 tons, will sink the base about 5 or 6 ft. below the line of the artificial bottom, as every foot the caisson sinks will displace fully 50 tons of water. The center of gravity will also be lowered by this action to about 18 ft. above the surface of the water. It will, therefore, not easily topple.

After it is got out beyond a certain distance it is proposed to let the water over the bottom 2 or 3 ft., to serve as ballast and lower the point of gravity still further. By attaching scows the base will be widened, while the resistance of the water to the outward movement will not be increased. The bottom will be of plate-iron, and will be protected at the point of the contact with the sides of the caisson with strong india-rubber to prevent leakages. The whole thing will have a framework of wood for attachment to the scows and to afford surface for grapling-irons, etc. This is the plan, in brief, as it has been agreed on. It was suggested two months ago, and was not then adopted because of the objections of the contractors. It will take nearly three weeks to do the work now. It will be a week before the caisson is raised. It will take another week to put in the bottom and a week to tow it out. Unless the matter is pushed with vigor there is danger that the removal cannot be made this year. The only difficulty will be to keep the caisson deep enough in the water, owing to the large floating surface of the bottom. The bottom will be so arranged and placed that it will be a matter of little difficulty to take it out when the caisson is in position.

THE proposed Great Western Ship Canal, connecting the Bristol and English Channels, according to the latest plant, would be 62 miles long, 125 ft. wide at surface, 36 ft. wide at bottom and 21 ft. deep. The preliminary estimate of cost is about $15,000,000. But this same estimate puts "the expenses of obtaining Act" at $696,325 and "contingencies" at $733,475. Under the safe but sometimes absurd English method of floating new schemes the first item may be all right; but the "5 per cent." set aside to cover the contingencies is surely as absurdly small, in the light of experience.

## The Glasgow Central Railway.

In the present session of Parliament a bill was passed authorizing the construction of a subterranean line to be called the Glasgow Central Railway, giving direct communication through the heart of Glasgow to the residential surburbs. Of this new railway we give an abstract from *Engineering*. The undertaking is certainly one of the most important of the kind proposed for a number of years, and when completed will be the longest underground railway in Scotland.

The new line will be about 7 miles long. It is a development of the Caledonian system; and here it may be said that, although not promoted nominally by the Caledonian Company, the shareholders and directors of that company have a large stake in the concern and the line will be worked by that company.

The line has eleven stations, these being on an average about a mile apart. At Bridgeton Cross, Stobcross, Kelvinbridge, Kelvinside, and the termini at Maryhill, goods and mineral stations will be formed. For the purpose of securing suitable and sufficient room for stations, considerable areas of land have to be purchased, and by the removal of the present buildings, many of which are by no means the most elegant in the city, street improvements will be effected.

In a city railway passing underground in the midst of large and valuable buildings, the nature of the subsoil is an important consideration, and we give in Fig. 1 a geological section, compiled from borings made along the route where the line is underground. This section shows the character of the strata to be dealt with, the level of the rails, and of high water of ordinary spring tides in the river at Glasgow.

In constructing the railway along the most crowded thoroughfares, viz., Trongate, Argyle Street, and Canning Street, the company are by the Act obliged not to open the surface except during a limited number of hours at night so as not to interrupt the ordinary street and tramway traffic. The only obstructions permissible are barricades, which are not to exceed 50 ft. in length by 17 ft. wide, to be placed 200 yds. apart for communicating with the underground operations. It will, therefore, be necessary in carrying out the works in those streets to use a temporary roof in the same way as in the completion of the inner circle lines of London. In this way, without interrupting the street traffic, the engineers are able to do all that is necessary for protecting the water pipes, gas pipes, and sewers.

The third cross-section given (Fig 2) is in London Street. Here the head room is limited, and the roof instead of being arched will require to be formed of iron, as indicated in longitudinal section.

Fig. 3 is a cross-section of Argyle Street, with an outline of the tunnel showing the width of the streeet, the relative position of the railway to the surface of the thoroughfare and the houses on one side. The width of the inside of the tunnel will be 26 ft. and the depth of the rails from the surface varies from 18 ft. to 23 ft. in Trongate and Argyle Street. The subsoil is sand containing water. Here the work to be done very much resembles that in Cannon Street, London, when the Underground Railway was being constructed. The first operation was to lay down at night, cross timber beams extending from one side of the street to the other, the length undertaken each night being such that the thoroughfare could be made suitable for traffic during the day. The beams were 12 in. by 12 in. placed 4 ft. apart. Upon them were placed longitudinally 4-in. planks, and on the top of these again 3-in. planks, laid at right angles to the road, as in the case of the beams. When a sufficient length of the plank roadway was completed a barricade was erected, which in Glasgow must not exceed 50 ft. long by 10 ft. wide, inside which a portable steam crane was used for filling carts with the excavated soil. The next operation was to drive the main head ing and from it cross-headings by which to approach the front walls of the buildings. Holes were sunk beneath the foundations and the underpinning concrete and brickwork placed in position. This done, attention was directed to the main trenches for the side walls of the tunnel and to the sewers. The trenches were about 9 ft. wide and necessitated alteration of the timbering, to support the roadway and the gas and water pipes. When the trenches were being filled with concrete, the sewers were constructed. The setting of the centre required another re-arrangement of timbering so as to allow room for the placing of the arched roof, which was constructed in lengths of 12 ft. Brick piers were built on the backing to support gas and water pipes. The earth in the inside of the tunnel was then removed and the invert placed in position in lengths of 12 ft. the sides being well strutted while the concrete was hardening. The earth was then filled in on the top of the arch, the temporary wooden street raised and the thoroughfare finally repaved.

We also give in Fig. 4 a cross-section in Stobcross Street, in which the subsoil is for the most part of sand, almost free from water. In this case there is not the same necessity for keeping the streets entirely open for traffic, and the operations will, in all probability, be the same as in constructing the parallel tunnel for the City and District Railway line—in Kent Road—where the sand was heavily charged with water. The first thing done was to drive at each side of the covered way a row of 6-in. sheet piling, until rock was found, the depth varying from 20 ft. to 30 ft. The space between the piling was then excavated, in lengths of 15 ft., to the shape of the top of the arch, and then filled in with the arch of concrete, 2 ft. 3 in. at the crown and 6 ft. at the sides. The street was then restored, the next length being meanwhile started. Preparations had been made for carrying the water away. It was drained in a sump and transferred by a syphon to the drain, to prevent sand being taken away with the water. A heading was started immediately under the arch and the water flowed to the sump. Two lines of sheet piling were then driven in the center of the covered way, 9 ft. apart, and the intervening space excavated. As the gullet thus formed became deeper, the ground on either side became dry, the water passing into the drains as described. The sides were next excavated, the concrete arch being afterwards propped up and supported on either side by 9-in. timbers, although not absolutely necessary, because the piling first driven had been notched to give the arch a catch. The hollows in the rock having been filled with concrete, the side walls were bricked. The excavating of the sides and the bricking of the side walls were done in lengths of 18 ft. The placing of a concrete invert, where the bottom was not rock, completed the operations. The engineers who carried out this work were Messrs. SIMPSON and WILSON, Glasgow.

The estimated cost of the new railway is $5,655,000, of which $1,135,000 is for lands and $4,522,500 for works To this, however, is added 10 per cent. for contingencies, bringing the cost per mile to about $885,000.

The engineers are Messrs FORMANS and MCCALL, C. E., Glasgow, and Mr. R. T. MOORE, civil and mining engineer, of the same city.

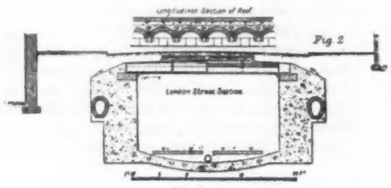



Fig. 2.

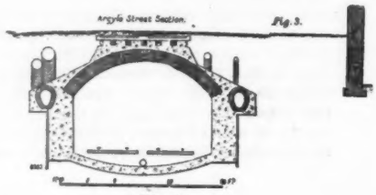



Fig. 3.

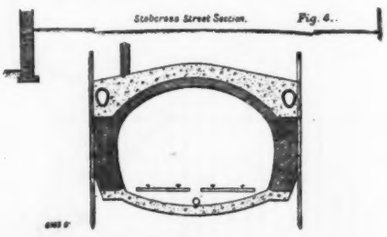
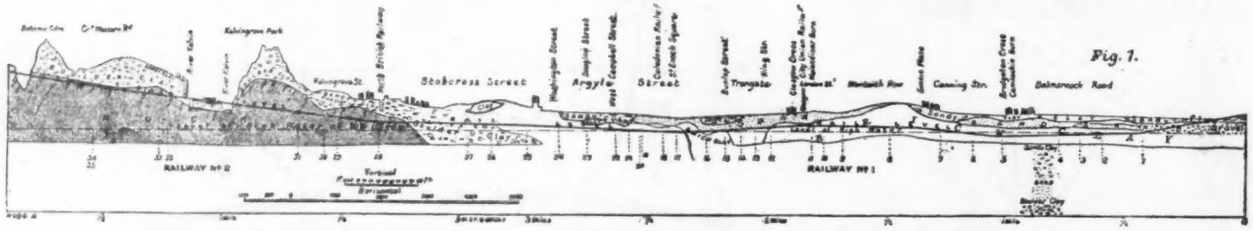



Fig. 4.




Longitudinal Section of Glasgow Central Railway; with Cross-Sections of Tunnel.

## Lowering the Masonry Shafts for the Quays of the Penhouet Basin, St. Nazaire, France.

The accompanying cut shows a highly ingenious method for lowering large masonry shafts which will, we are sure, be examined with much interest.

The quay-walls proper of the Penhouët Basin at St. Nazaire are 10.60 metres high. The mode of construction varied greatly, because at some points the bed rock is found at the level of the top of the walls, whereas at others it is 18 metres below the bottom of the basin. They are all built on rock, however, passing from a simple revetment to a solid mass and then to a system of arches of which the piers are masonry shafts lowered down through the mud.

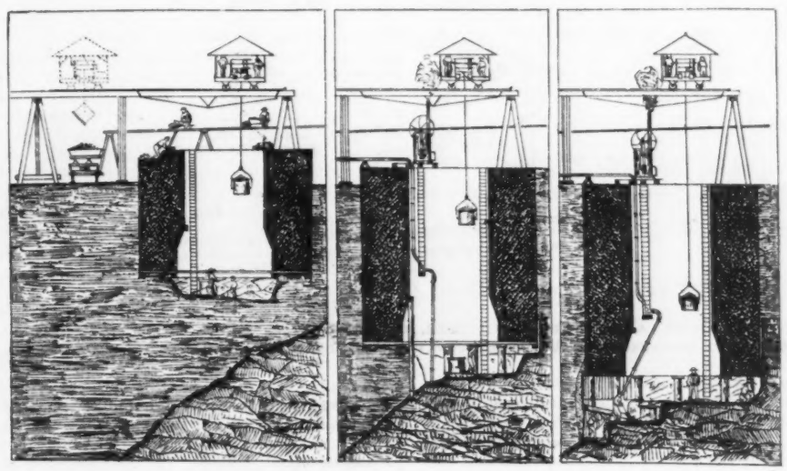
There was nothing special to be noted in regard to the foundation so long as rock was found at less than 4 metres below the bottom of the basin. Within these limits a simply trench sufficed, the only difficulty being to determine the slope necessary to give to the sides of the excavation in the alluvium.

It was found that, with depths of 10 to 14 metres, it was necessary, in order to maintain the slopes, to make them in steps 1 metre high and at an inclination of 1 vertical to 2 or 3 base.

When the trench reached more than 4 metres below the bottom of the basin, the slopes of the excavation were so unstable during damp seasons that there had to be adopted a system of foundations by means of shafts, or wells, sunk in place through the entire depth of the alluvium. These shafts form, when they are firmly seated and filled, solid piers which are afterwards connected by means of full-center arches of 6 metres diameter. The quays are built on these arches. The lowering of these shafts was done in the open air and no serious trouble was found so long as the masonry mass was moving in the mud: but when one of its sides or angles touched the

solid rock it was another matter. The slope of the rock being frequently 2 or 3 horizontal to 1 of height the unsupported base was so great that it was impossible to hold up the shaft or to inclose with sheeting the prism of mud beneath it. The first shafts on the north side measured 11 metres by 5 with a hollow inside 5 metres by 2. The slope of the rock was in the direction of their greater dimension; whence it followed that when the west side of one of them struck the rock there was still a depth of 6 metres of mud under the east side. No hesitation was felt about letting them down on a regular bed cut from the solid rock. The novelty of the work is in this very delicate operation, illustrated in the cuts, of which the following is a brief description.

When the shaft touched the rock at one of its outer sides, heavy piles, 0.40 m. to 0.50 m. [16 to 20 in.] square, were driven along the opposite inner side. They were then cut off at a height of 1.50 m. to 2.00 m. above the lower platform of the masonry mass and forced by means of hydraulic jacks under



Sinking Piers at St. Nazaire, France.

a strong sort of cap bedded in the masonry. The mud was dug away for a depth of 1.50 m. beneath the shaft and the work was cut away by picking or blasting so as to remove a triangular prism of which the lower face should be horizontal. As the work progressed, heavy props were so arranged under the shaft as to support it; then, when the the rock was all removed, an auger hole was bored half way through each prop, a dynamite cartridge weighing 50 grammes [1¾ ounces] was placed in each hole and fired by means of an ordinary fuse 1 m. long. All the props were split and crushed. The mass of masonry then went down either by breaking the long piles or their cap, which had been intentionally left untouched so as to get some resistance on the side of the mud. This resistance and the mattress of mud which was forced aside caused a very regular and vertical descent. The operation was then repeated as often as necessary, the shaft each time being let down 1.50 m., until the mass was finally set on a rock bed of which the horizontal surface was sufficiently great to do away with all fear of upsetting, and to allow the mud remaining on the inside to be easily removed without danger from that on the outside being forced in.

In this way, by three successive operations, the great abutment of the northwest side was let down 4 meters into the rock. This shaft measured 9 metres by 12 and weighed 2,200 tons. It was supported at its last letting down by 25 props each about 18 ins. square. Twenty quarry men worked under it in perfect safety.

To make the sinking easier and more economical, the shafts were divided into two, one being placed in rear of the other, when the soundings showed that the pitch of the rock was very steep. The number of operations was greatly reduced in this way; the volume of rock to be removed was still more reduced, and when the shafts were in place it was merely necessary to remove the mud between them and fill the space with masonry. But this system had disadvantages, the shafts were not so heavy and did not go down well on account of the side friction of the mud, so it was often necessary to weight with 80 to 160 tons of pig iron in order to start them. Besides this, the rear shaft was shoved by the difference in pressure of the mud behind and in front against the front shaft, so that excavating between them was sometimes hard. The two shafts being 5 m. by 5 m., and the space between being 2 m., it almost always happened that in going down 10 to 15 m. into the mud they approached within 1 m. of each other.

In spite of the exceptional difficulties, and of many slips in the slopes of the exterior excavations, and of the constant forcing up of mud on the inside of the shafts, the work was done quite cheaply.

The cost per cubic metre of the piers (everything included and the excavated material carried 1,100 yds.) was only 62 francs, or $9.49 per cubic yard. 35,000 cu. m. (45,500 cu. yds.) were founded in this way. The quays support the whole weight of the outside embankment and they are perfectly stable, no movement having been noticed along the face of the basin.

We are indebted to Capt. F. A. MAHAN, U. S. Engineers, for the notes of this ingenious and novel bit of foundation work, and for the accompanying illustration.

## The Surface Improvements of Washington, D. C.

Capt. T. W. SYMONS, Assistant to the Engineer Commissioner of Washington, D. C., has sent in his report on the surface improvements of that city for the last fiscal year. He shows the expenditure of $350,000 in that time, $45,000 on Georgetown and the remainder in the city proper.

The asphalt-block pavements laid last year, he says, have developed remarkably good qualities; and under the influence of summer heat and travel they have softened and cemented together so as to form a pavement difficult to detect from sheet-asphalt. The amount appropriated for street improvement for 1888-89 is $615,000.

While recommending brick sidewalks for the streets still under improvement as satisfactory and cheap, he calls attention to the pressing need of a better material in the heart of the city. The fact that pipes for various uses are laid under the sidewalks precludes sheet asphalt; but asphalt block and tile, good flagging or artificial stone would do. The curbs used last year were 5×20 in. bluestone and 6×20-in. granite; these being set on the narrow side settled unevenly. An 8×8-in. special granite curb set on a base of hydraulic concrete 18-in. wide and 9-in. deep was an undoubted success, and this year a large part of the curb to be set will be of this character.

Capt. SYMONS recommends the resurfacing of Pennsylvania Avenue from the Capitol to the War Department, as the present pavement is in a wretched condition and beyond repair by patching. He also recommends the raising of the Anacostia bridge 10 ft., that it be doubled in width and a new draw-span be constructed, with an embankment to replace the six spans to be removed from the eastern end of the bridge. The bridge is now 1,256 ft. long and 20 ft. wide, with two sidewalks of 5 ft. each. It is only 9 ft. above high water. The estimated cost for reconstructing Anacostia bridge, the work to include the removal of six spans on the Anacostia side and placing them beside the present bridge on the Washington side, and constructing an earth causeway in place of bridge removed is as follows:

| | |
|---|---|
| 300 piles and driving, at $10 | $3,000 |
| 50,000 ft. B. M. timber and plank in foundation | 1,500 |
| 1,000 cu. yds. of masonry, at $20 | 20,000 |
| 1,000 cu. yds. of masonry, at $12 | 12,000 |
| Building 1 span draw | 1,500 |
| 3,200 cu. yds. rip-rap around foundation | 4,800 |
| 1,000 cu. yds. rip-rap on causeway slope | 2,000 |
| Taking down and setting up six spans of bridge | 5,000 |
| 27,000 cu. yds. filling in causeway | 18,300 |
| 3,700 sq. yds. macadam roadway | 2,300 |
| Coffer-dam, pumping, and dredging | 5,000 |
| Floor beams, floor, and painting | 1,500 |
| | $77,020 |
| Contingencies 10 per cent | 7,702 |
| Total | $84,722 |
| In round numbers | 85,000 |

The report closes with the following:

SUMMARY OF APPROPRIATIONS AND ESTIMATES.

| Items. | App'n 1887-88 | App'n 1888-89 | Estim'e 1889-90 |
|---|---|---|---|
| Street improvements: | | | |
| General schedule | ..... | 144,690 | 250,000 |
| Georgetown | 45,000 | 38,600 | 51,650 |
| Northwest | 140,000 | 191,400 | 341,505 |
| Southwest | 50,000 | 52,800 | 69,025 |
| Southeast | 65,000 | 54,400 | 151,775 |
| Northeast | 50,000 | 129,700 | 144,005 |
| Replacement of wood | ..... | 3,509 | ..... |
| Relaying sidewalks | ..... | ..... | 30,000 |
| Current repairs to streets, avenues and alleys | 30,000 | 35,000 | 50,000 |
| Repairs to concrete pavements | 80,000 | 95,000 | 100,000 |
| Resurfacing Pa. Ave., 1st to 17th Streets | ..... | ..... | 130,000 |
| Permit work | 90,000 | 90,000 | 200,000 |
| Constructing county roads and suburban streets | 50,000 | 88,980 | 225,000 |
| Repair county roads and suburban streets | 25,000 | 45,000 | 60,000 |
| Filling streets below grade, grading, etc | 10,000 | 15,000 | 15,000 |
| Construction and repair of bridges | 9,500 | 14,500 | 12,500 |
| Ordinary care of bridges | 2,500 | 2,500 | 3,160 |
| Impr'vem'nt Anacostia Bdg. | ..... | ..... | 85,000 |
| Purchase of property yards | ..... | ..... | 30,000 |
| District stable | ..... | ..... | 15,000 |
| Lighting: Gas | 100,000 | 105,000 | 120,000 |
| Electricity | 30,000 | 30,000 | 40,000 |
| Parking Commission | 18,000 | 18,000 | 30,000 |

A CANAL ACROSS ITALY.—It is proposed to commence a canal upon the western shore of Italy, just above Civita Vecchia, at Castre, and to cut through to Fano on the eastern or Adriatic shore. A glance at the map of Italy will show that in this line two lakes are met, those of Bolsena and Trasimeno, and it is proposed to drain these two lakes, thus securing the area for cultivation. The length of the canal will be about 169 miles, the width of it 110 yards, and its depth is to be about 39 ft., so that ships of any tonnage, and even men-of-war, will be able to pass through it. The cost of the canal is reckoned at 500 000,000 francs, that is, $100,000,000. It is estimated that the work could be completed in five years from its commencement. The Italian journals are highly interested in the project and are taking up the matter warmly, and when the fact of the long sea passage round the south coast of Italy and up the stormy Adriatic to Trieste and Venice is remembered, certainly the canal would be of immense service to the whole of Southern Europe.—*London Figaro.*

A UNIFORM steam-pipe coupler for car heating is the one great problem now before the Railroad Commissioners at Albany, and the lack of this desideratum is the one stumbling block in the way of the universal adoption of steam heating on cars; at least so say the railway companies. The coupler problem may be used as an excuse for delay, but uniformity in this direction is most desirable, and a multitude of inventors are attempting to solve the difficulty, If the public must take its chances with the car-stove for another winter, we trust it will be the last.

SEVEN out of every ten railroad accidents are settled with an annual pass. Some men would be run over by a whole freight train for the sake of a few free rides.—*Detroit Free Press.*

## The Sweetwater Dam.

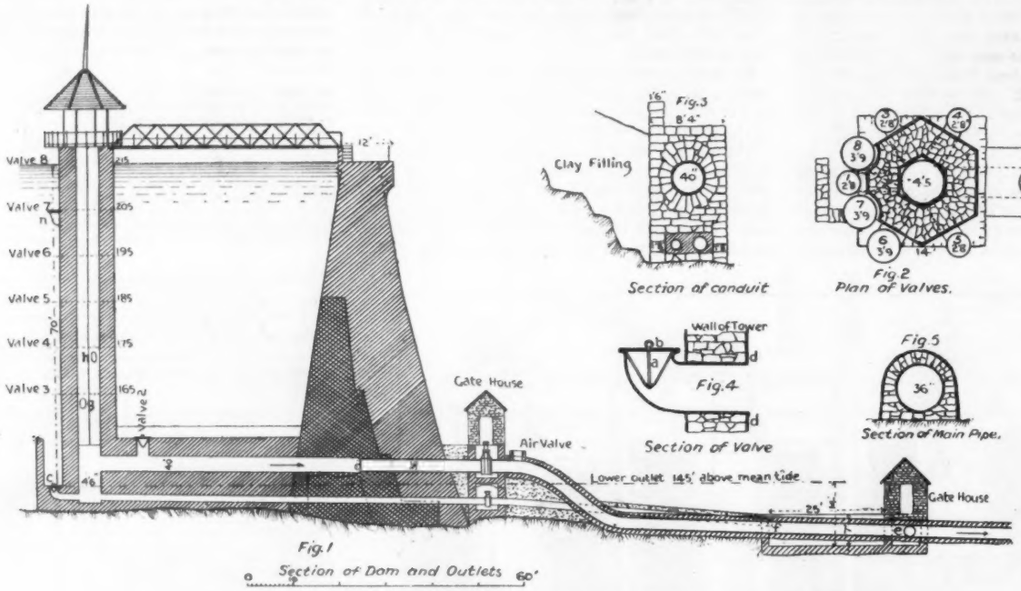
At the last meeting of the Am. Soc. C. E. Mr. JAMES D. SCHUYLER, Member, presented one of the most interesting and valuable papers received by the Society for a long time. It had for its subject the construction of the Sweetwater Dam, in San Diego Co., California, designed and built by the author. This dam was intended for storing water for the irrigation of large tracts of land and the supply of National City.

The builders were the San Diego Land & Town Co. (a first cousin of the A. T. & S. F. R. R. Co.), which already owned a large body of fertile land and ¼ to ⅝ miles wide which formed the site of the reservoir.

The construction of the dam was decided upon in Nov. 1886, and a small dam was then started, made of concrete, 50 ft. high, 10 ft. wide at bottom, 3 ft. wide at top and arched up stream with a radius of 225 ft. On the upper side was to be an embankment of loose earth. After two months work and the expenditure of $35,000 the project was further developed and Mr. SCHUYLER was called in to design a suitable structure. The writer modified the original radically; he rejected concrete construction, the bank of water-charged earth, and adopted a gravity profile with masonry of 4 ton blocks.

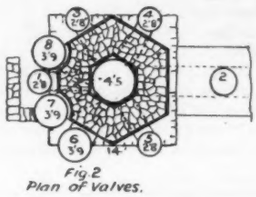
15 ft. it was drawn in to a thickness of 24 ft. (where the pipes left the dam) and from this point the dam was carried to a height of 45 ft. with a top width of 5 ft. The face batter up-stream was 1 in 6. In anticipation of adding to the height of the dam, the back was built in 3 steps. The stream was carried during construction in a wooden flume 30 in. square.

By June 1 the dam was 60 ft. high instead of 50 ft. as originally intended, and it contained 7,500 cu. yds. of masonry and had cost (including preliminary experiments) about $100,000. In the meantime Mr. SCHUYLER's surveys had developed the fact that a dam 90 ft. high would impound 5,882 million galls.,







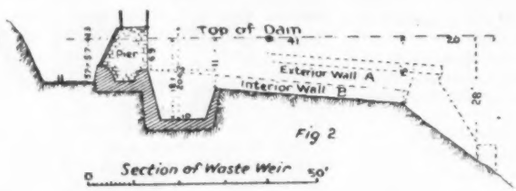


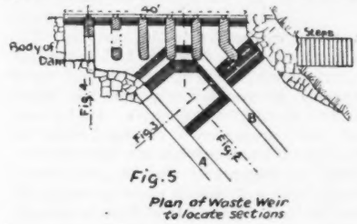


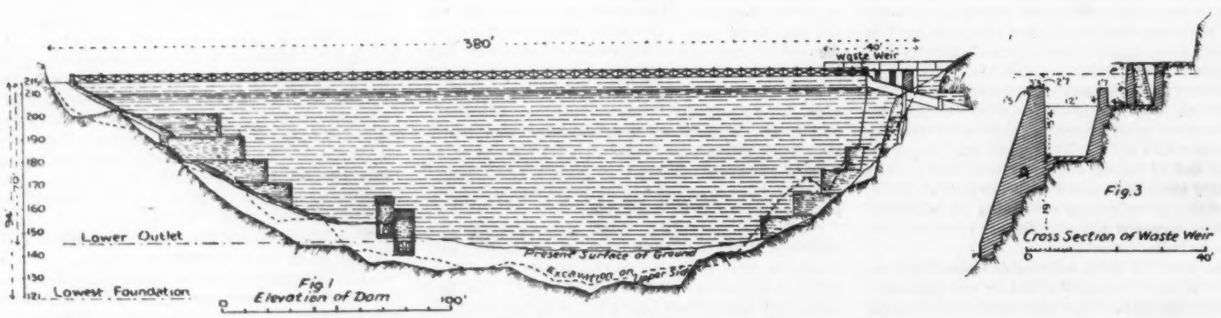





**Sweetwater Dam; Gate-House, Etc.** JAMES D. SCHUYLER, *Engineer.*
(The cross-hatching shows the first 60 ft. dam, with a section of the first proposed still smaller dam within it.)






**Sweetwater Dam; Cross-Section of Valley, Waste-Weir, Etc.**

that was unsaleable owing to the lack of water. The Sweetwater river is one of the intermittent streams found in that region, practically dry until December, and then for a short time after each heavy storm discharging from 500 to 1000 cu. ft. of water per second; by June 1, the stream has again dwindled to 1 or 2 cu. ft. per second. To store the storm water this dam was built in the first cañon above the mouth of the river. This was a deep and narrow gorge half a mile in length through a trap dyke, intersecting the valley of the Sweetwater, and leaving above it a broad level valley about 3 miles long

To "save the money" already expended, the work done was utilized as much as possible, and the arched form was necessarily included, but the bank of loose earth was replaced by well-rammed clay puddle. The foundation was very hard solid rock, but presented a number of cones thrown together. Great care was taken in cleaning out all seams, scrubbing them by hand and washing with thin pure cement before starting any masonry; similar care being taken with the anchorage in the sides. To meet a pressing demand for water, the new dam was hastily run up with a base of 36 ft.; at the height of about

while the 60 ft. dam would only store 1221 million galls., and as the increased store would so considerably increase the commercial value of the improvement in times of drouth, it was determined to raise the dam as recommended by the writer.

In designing the higher structure greater reliance was placed on the arched form, and while the profile adopted was one theoretically giving stability by its own gravity, the factor of safety was not so large and the line of pressure fell about the center of the lower third. It was reasoned that as the foundation was as near perfection as can generally

be found, apprehension on that score was unnecessary, and the fact that other great masonry dams had failed in the foundations need not be regarded as a factor in this case. Mr. SCHUYLER says:

"If one can imagine a monolith to be carved in the form of a true arch of such weight and dimensions that any section of it is capable of withstanding the pressure of quiet water against its full height without sliding or overturning, and such a monolith be firmly wedged between the rock-bound walls of a narrow cañon, the possibility of its being ruptured, displaced, or destroyed from water pressure alone cannot readily be conceived. Now, if by the use of rich cement, mortar and best of building stone a structure be formed of the same dimensions and in the same position, which in time becomes virtually a monolith, based on the firmest of bed-rock, its stability must be equally secure in the mind."

The dimensions of the new dam were as follows:— Base 46 ft., top thickness 12 ft., height 90 ft., radius of arch 222 ft. on line of face at top. The face batter 1 in 6 was carried to within 6 ft. of the top, thence vertical to the top of the parapet wall. The batter at the back started at the toe with 1 in 3 for 28 ft., then 1 in 4 for 32 ft., thence 1 in 6 to the coping.

In construction special care was taken to secure a perfect footing for the toe; the slight leakage found when the former work was stripped (10,000 galls. daily) was entirely cut off by wells and grout; the first masonry was exceptionally good and tight. The stone used was dark blue and grey metamorphic rock impregnated with iron. The grey was full of minute quartz crystals and the blue was slightly the heaviest as carrying more iron. This rock came from a quarry 800 ft. below the face, had no well defined cleavage, but usually had one or more tolerably good faces and it had a specific gravity of from 175 to 200 lbs. per cu. ft. The average weight taken in calculation was 164 lbs. per cu. ft. of masonry. Portland cement of the best quality was used in the proportion of 1 cement to 3 of sharp clean river sand, and for the 4 ft. next to the water a richer mixture of 1 to 2 was employed. From May 1 to the completion of the work the mortar was mixed in a machine patented by Mr. E. L. RANSOME of San Francisco. This was a square box, mounted at diagonal corners, with a perforated tube for water passing through the bearings. The ordinary charge was 3 barrels of sand and 1 of cement, dumped in a hopper over the box. The dry materials were given 3 or 4 revolutions and all the water required was then added in the next 3 or 4 turns; 8 to 10 turns in all were sufficient to thoroughly mix the mortar, which was dumped in a box on a car under the mixer, and this car was then run under the derrick and the box was hoisted and delivered where wanted. The box had a hinged bottom for discharge. A tramway ran along the face of the dam at the 60 ft. level, supported on brackets suspended from bolts, and was used to the end of the work in the delivery of materials, with great economy over previous methods of delivery by hod-carriers.

The stone was hauled on wagons and on stone-boats made of 3 in. plank with boiler iron bottoms (cost $30 each), and placed on these from simple shear-leg derricks. All the hoisting was done by horse-power, as fuel was scarce and dear, and earlier experience had proven to the writer that horse power was the most economical and convenient. Four derricks were in constant use on the wall, with 30 to 38 ft. mast and 26 to 32 ft. booms. A later and longer fifth derrick with 50 ft. mast and 45 ft. boom proved to be so much superior to the others that it was a matter of regret that they were not all of the larger size. There was no loss of human life and no serious accident during the work.

The work was finished April 7, 1888, having occupied 16 months in construction, including 2 months of delay on account of shortage of cement. The total volume of masonry laid was:

| | | |
|---|---|---|
| Dam proper | 19,389 | cu. yds. |
| Wasteway | 481.2 | " |
| Inlet tower | 376.8 | " |
| Conduit, from dam to tower | 182. | " |
| Gate House | 71. | " |
| Various accessories | 127. | " |
| Total | 20,507 | cu. yds. |

In this work 17,562 barrels of cement were used, an average of 1.17 cu. yds. of masonry per barrel of cement. The total cost of the dam was $234,074.11, distributed as follows:

| | |
|---|---|
| Plant, tools, etc | $6,236.76 |

MATERIALS.

| | | |
|---|---|---|
| Cement | $63,111.03 | |
| " hauling | 8,614.18 | |
| Lumber | 2,408.08 | |
| Iron work | 4,915.90 | |
| Pipes, gates, etc | 5,152.58 | |
| Misc. materials, powder, etc | 3,229.84 | 87,431.70 |

LABOR.

| | | |
|---|---|---|
| Common and skilled | $93,560.55 | |
| Foreman | 6,866.49 | |
| Teams | 19,686.12 | |
| Engineering, salaries, etc | 10,555.20 | |
| Clerical work | 653.88 | |
| Earthworth (contract) | 7,666.51 | |
| Misc. expenses | 1,376.90 | 140,405.65 |
| Total | | $234,074.11 |

The cost for the flowage tract is not included in the above. A little more than half the land cost $16,426.93; the remainder is in litigation under an action of condemnation. A San Diego jury under the stimulus of "boom" prices awarded $280 per acre for land which was one-third worthless and the remainder unimproved. The clearing and grubbing of about 300 acres of the reservoir basin cost $10,800.46.

Careful note taken weekly of the volume of masonry laid and the expense of so doing brought out the following interesting data showing the average cost per cubic yard of 11,322 cu. yds. of masonry laid from May 1 to Dec. 31, 1887:

| Items. | Cost Dollars. | Cost p. yd. of masonry. Dollars. | Per ct. of tot'l cost. |
|---|---|---|---|
| *Cement*, 9,237 bbls. at $4.20 | $38,795.40 | 3.427 | 38.9 |
| *Stone*, quarrying | 4,816.23 | .425 | 4.829 |
| loading | 5,917.83 | .523 | 5.933 |
| hauling | 4,756.75 | .420 | 4.758 |
| hoisting | 6,531.52 | .577 | 6.550 |
| *Sand*, loading and hauling | 3,902.61 | .345 | 3.915 |
| *Mortar*, mixing and delivering | 2,709.27 | .239 | 2.710 |
| *Masons* | 9,025.05 | .797 | 9.050 |
| *Helpers* | 2,101.30 | .186 | 2.109 |
| *Excavation of foundations* | 3,433.16 | .303 | 3.444 |
| *Making and repairing roads* | 1,332.30 | .118 | 1.336 |
| *Blacksmith* (labor) | 1,847.97 | .163 | 1.854 |
| *Carpentry* | 1,100.29 | .097 | 1.104 |
| *Rope* | 1,181.70 | .104 | 1.186 |
| *Tools* | 521.68 | .046 | .524 |
| *Steel* | 153.59 | .014 | .155 |
| *Blacksmith Coal* | 107.48 | .009 | .109 |
| *Blocks and Sheaves* | 131.44 | .011 | .133 |
| *Powder* | 971.00 | .086 | .974 |
| *Foremen* | 3,763.11 | .332 | 3.774 |
| *Engineering & Superintendence* | 3,880.00 | .343 | 3.891 |
| *Lumber* | 2,212.92 | .195 | 2.220 |
| *Wetting Masonry* | 540.15 | .048 | 0.542 |
| Total | $99,726.25 | $8.808 | 100.000 |

The waste way was designed to carry the probable maximum flow of the stream with a full reservoir. It was located at the south end of the structure, and is 40 ft. in length by 5 ft. deep, and is divided into eight bays of 5 ft. each, formed of masonry piers. These piers had recesses on the upper side for loose flash boards of 2-in. plank, resting on an incline of 30° from the vertical. The water passing over the weir thus made falls into a series of pools, 3 ft. deep, which relieve the structure of shock, and then passes down an inclined plane of 1 in 10, and at 50 ft. from the dam it plunges into the cañon below. The capacity of the waste weir is about 1,500 cu. ft. per second, which may be increased to 1,800 cu. ft. by opening a 30-in. blow-off in the main pipe below the dam.

The inlet-tower is located 50 ft. above the dam nearly opposite the center. It is built of masonry with cement mortar mixed 2 to 1, and plastered inside and outside with two coats mortar mixed 1 to 1 of sand and cement. It is 16 ft. square at the base for a height of 10 ft., where it is changed to a hexagon with walls of a uniform thickness of 3 ft. to the top. Each of the sides of the hexagon measures 3 ft. and into them are set seven cast-iron elbows placed 10 ft. apart with the mouth up, the upper one being 10 ft. below high-water level. The bell-mouth is usually closed with a plain cast-iron cover; but as the design is to draw water from the surface wherever that may be, these covers can be removed and a strainer lowered in its place from above. Three pipes pass through the dam and enter the tower at the bottom. The two lowest pipes are of cast-iron (14 and 18 ins.) and are encased in concrete throughout. On top of these is a conduit of masonry, circular in form and 40-in. in diameter, formed of walls 30-in. in diameter in double arches. This conduit leads from the interior of the tower to the center of the dam where it joins a pipe of ⅜-in. boiler-iron 36-in. in diameter leading to the main gate immediately below the dam, and from this gate is carried the main pipe-line down the valley. The smaller pipes are intended to feed a turbine for pumping water to a higher level.

The reservoir has a red-clay soil bed outside of the old river bed and is impervious in its nature. A table with successive 5 ft. levels of area and storage capacity of this basin shows that 80 per cent. of the water is stored in the upper 30 ft. of height, and that 40 per cent. is within the last 10 ft. This fact reduces within small limits the fluctuation of head on the mains after the reservoir is once filled and demonstrates the wisdom of increasing the height of the dam, by largely increasing the irrigable area.

The cement used was such as could be obtained in San Francisco markets in a time of scarcity. The average cost was $3.60½ per barrel at San Diego, and it cost 70 cts. per barrel to haul it to the dam. The masons were paid $4.00 to $5.00 per day, common labor $2.00 to $2.50, foreman $4.00 to $6.00, carpenters $3.50 to $4.00, blacksmiths $4.00, teams including driver $5.00, and machinists 80 cts. to $1.00 per hour. The work was done in the midst of the "boom" in Southern California and labor of all kinds was difficult to obtain and hard to hold. As to the prophesy that the reservoir would fill up by sand washed down the valley, Mr. SCHUYLER figures that a reasonable estimate defers this event for 1,000 years.

The distributing system is as follows:— From the dam to the lower end of the cañon, 1,600 ft., it is 36 in. pipe covered with masonry laid in lime mortar and plastered with cement. From this point it reduces to 30 in. diameter, and follows the valley for 5 miles, and thence rises to the top of the Chula Vista Mesa, 92 ft. above sea-level. Its entire length is 29,800 ft. and at its terminus it is divided into two 24 in. pipes, one running south one mile, the other west half a mile, where it is reduced to 18 in., and is carried northward to and through National City.

Wrought-iron pipe was used throughout. The total length of mains and laterals laid is 58 miles, with 5¼ miles on hand to be laid this season. The pipes are of three classes, viz.: straight, double-riveted pipe made and laid by the Risdon Iron Works of San Francisco; Converse lock-joint Kalameined lap-welded tube, made by the National Tube Works of McKeesport, Pa., and spiral riveted pipe made by the Abendroth, Root Man. Co. of New York. The length and diameter of each class of pipe used was as follows:

| | | | |
|---|---|---|---|
| RISDON IRON WORKS. | | | |
| *Wrought-iron, straight riveted* | 36 in. diam. | 1,594 ft. | |
| | 30 in. " | 28,213 " | |
| | 24 in. " | 2,034 " | |
| | 18 in. " | 16,468 " | |
| NATIONAL TUBE WORKS. | | | |
| *Kalameined tube* | 12 in. diam. | 25,908 ft. | |
| | 8 in. " | 7,620 " | |
| | 6 in. " | 132,333 " | |
| | 4 in. " | 50,745 " | |
| ABENDROTH, ROOT CO. | | | |
| *Spiral steel and iron* | 24 in. diam. | 5,950 ft. | |
| | 12 in. " | 10,020 " | |
| | 8 in. " | 4,020 " | |
| | 6 in. " | 17,870 " | |
| Total | | 302,779 ft. | |

The introduction of spiral pipe into the system was unfortunate, as it did not stand the test of transportation across the continent, and will have to be taken up and specially "treated" to make it water-tight. It would answer well for sub-irrigation if it could be properly controlled, but in streets and avenues it is not desirable.

The total cost of the pipe lines laid was as follows:

| | |
|---|---|
| Pipe | $301,928.80 |
| Freight | 20,183.01 |
| Distribution | 6,271.06 |
| Gates | 1,849.62 |
| Material, tools, etc | 5,932.57 |
| Right of way and Misc. expenses | 2,968.00 |
| Pipe laying | 144,630.78 |
| Total | $502,763.86 |

In figuring the duty of the works, the assumption is made that in average years, say 3 out of 5, the watershed will yield a sufficient supply to fill the reservoir and maintain the consumption through the rainy season. This would start the irrigation season, about May 1, with a full reservoir. From May 1 to Oct. 1 is the average season of irrigation, about 150 days. Where the pipe distribution is in use a fair average allowance for Southern California is a duty of 10 acres per "miner's inch" (500 acres per cu. ft. per second); though a higher duty of 40 acres per miner's inch has been secured in one

place. Allotting 700,000,000 galls. for the annual consumption of National City and for loss by evaporation, the remainder would yield a flow of 2,000 miner's inches per day for 200 days. With a duty of 10 acres per inch, this amount would irrigate 20,000 acres. In the course of time it is expected that the duty can be raised to 20 acres, and in such a case a full reservoir would extend over two years and still irrigate 20,000 acres.

Water rights, giving to the purchaser simply the privilege of becoming a customer for water, have been sold by the San Diego Flume Co. at the rate of $2,000 per miner's inch. At this rate the value of the irrigation supply of the reservoir is $4,000,000. The construction of the works has already added $1,500,000 to the principal tract of 5,000 acres which has been supplied with a complete system of water pipes, and another million to the value of town property in National City and lands adjacent.

## The Chignecto Ship Railway.

The small map herewith illustrates the location of this work, which, as we have noted elsewhere, is likely to at once go forward. On the map are given notes of the tonnage (of 1887) more or less tributary to the canal, but the precise tonnage which it will enjoy for the next 20 years is a minor question in view of the fact that the enterprise will enjoy a subsidy from the Dominion Government of $175,000 per year for 20 years, which is nearly 6 per cent. of the estimated cost; the aggregate subsidy being $3,500,000, or somewhat more than the expected actual cost. The contract price for the work is $5,000,-

**Map Showing Location of the Chignecto Ship Railway.**

[Shipping of Bay of Fundy, 1887, 2,618,144 tons with cargo; 1,323 019 tons in ballast; of Gulf and River St. Lawrence from Quebec eastward only, 6,241,164 tons.]

000. Mr. BENJ. BAKER and Sir JOHN FOWLER, of the Forth Bridge, are the engineers of the work, and with them is associated Mr. H. G. C. KETCHUM, of Fredericton, N. B., as the "resident" engineer.

The contractor is the well known HENRY MEIGS, an American, but now a prominent London contractor. The hydraulic lifts are in the hands of the designer of the great Malta dock, and in general the elements of uncertainty seem to have been pretty well eliminated. The location is an admirable one for a first experiment of this kind. The total length is about 17½ miles, in one straight line, and with no grade exceeding 10 ft. per mile. The greatest cutting is some 45 ft. The road-bed is to be usually 40 ft. wide with two tracks laid down on it, and the maximum load which it is proposed to transport is of 1,000 tons burden. All shaky or doubtful material is to be carefully removed from under the road-bed, and the specifications provide for testing the track before acceptance by increasing loads of 500, 1,000, 1,500 and 2,000 tons, the contractor being obligated to make good all defects of surface which may develop under each test before advancing to the next test.

The tides in the Bay of Fundy rise 60 ft., which somewhat complicates the problem. It is not expected, however, to make the lifts accessible at the absolutely lowest tides. At about mean tides vessels will be able to enter the cradles, the mechanical construction of which we shall illustrate later. At present the contractors are unwilling to make the plans public. The contract date for the completion of the work is September, 1890, or two years from the signing of the contract.

## CORRESPONDENCE.

### "The Bad Work on the Croton Aqueduct."

BOSTON, Mass., Oct. 18, 1888.

EDITOR ENGINEERING NEWS:

After reading your accounts of the "Bad Work on the Croton Aqueduct", it seems to me that most of the blame should properly be attached to the Division Engineers in charge who received or accepted the work, and that whether those voids of 820 barrels total capacity were overlooked through carelessness and neglect of duty or through guilt, the honor of the profession would demand that all parties connected with such scandalous work be exposed. Cannot you give your readers a list of the names of the engineers and inspectors on whose division the "bad work" was allowed? E. G.

[This journal exists to give and to discuss engineering news, not the acts or motives of individuals, which we do not attempt to judge, and certainly are anxious not to misjudge.—ED. ENG. NEWS.]

### A Query as to Sluice Gates.

SANTA CATALINA, Mexico, Sept. 25, 1888.

EDITOR ENGINEERING NEWS:

I should like to get the opinion of yourself, or of some of the readers of the ENGINEERING NEWS, on the best form of sluice gates, or valves, to put in a masonry dam of about 40 ft. height; which gates would be near the bottom of the dams, as they are for irrigation.

When I say the best; I mean rather a gate that will answer the purpose for which it is required without getting out of order, or costing as much money as a valve tower, etc.

This question will be of interest to other readers besides myself. Hoping to hear something on the question, I am yours faithfully,

H. TILLY BROWNE, C. E.

[Practice is very varied, and what form is "best", if any can be said to be always so, is a very dubious question. We shall be pleased to hear from correspondents engaged in irrigation.—ED. ENG. NEWS.]

### A Short Formula for Bearing Piles.

CINCINNATI, O., Oct. 14, 1888.

EDITOR ENGINEERING NEWS:

Many engineers have difficulty in arriving at "short rules" which can be quickly applied to the special matter under consideration. The question "How hard shall we hit a pile to produce an intended result" has been so surrounded by algebraical pyrotechnics that most of us doubt the "formula foundry", but keep dark for fear of exposing our ignorance.

We must thank Mr. RUDOLPH HERING, C. E., for his valuable collection of formulæ in his pamphlet on "Bearing Piles", which every practicing engineer should read and digest—if he can. But believers in evolution will understand that the "Formula must be the development of the experience protoplasm." The professors give us fine-spun theories covered up under Greek characters, but the mistake they make is in attempting a blanket rule that covers too much of the earth. What is needed is a home-spun rule of the work-a-day type, embracing the conditions of a railroad trestle with bents 12 to 15 ft. apart, and 4 or 5 piles to a bent. Such a rule need not be of the "scatter-gun" kind, including hammers from 1 to 40 tons in weight and piles from 10 to 300 ft. in length.

I would now ask permission to submit to the criticism of engineers a rule that is evolved from 15 years experience in its use and one that has borne the test of time as applied to railroad trestles as before described, and with piles of 12 in. minimum diameter driven about 10 ft. into the ground. Under these conditions the supporting power of the pile is derived from the friction area of 30 sq. ft. or more, and at least one-third of the pile imbedded by blows from a 2000 lb. hammer. We do not warrant the rule to work outside of these limits, but affirm that it does work within them.

An old and experienced contractor once gave us as his rule in such cases provided—"Drive 'em till they will hold up the train good, and then—pull off". The writer has followed this rule ever since, and none of his trestles have "slumped", proving that at least "the modulus of sufficiency" has been duly considered. There is no use in "brooming" a pile simply to comply with MOSSBACK'S formula of

$$\frac{3}{\sqrt{S.\ T\ 1860.\ X;}}$$

it will be found cheaper for all parties concerned in good work to use more "pile area" and less "shattering force", supposing that a pile trestle is the correct structure.

Experience has shown that the blow of a 2,000 lb. hammer falling 30 ft. is too severe, even for a good white-oak pile 30 ft. long and 12 ins. in least diameter, when the penetration is only ⅛ in. per blow, after previous blows of same penetration. The pile will burst below the band after a half-dozen such blows. The 2,000 lb. hammer falling 14 ft. with *one-inch* penetration is all sufficient for the conditions of a railroad trestle stated. So a 26 ft. fall with 2 in. penetration is taken as equivalent to the foregoing and likewise "enough."

From the above practice the writer would suggest the following specification for piles driven with a 2,000 lb. hammer on the standard plan railroad trestle: The penetration with 14 ft. fall to be 1 in. or less, and the penetration with 26 ft. fall to be 2 ins., or less. Between these limits a fall of 3 ft. to correspond to one quarter inch penetration as equivalents.

Rules are like puddings to be proved by the eating and I would like to see "some of the brethren give their experience" with other hammers and with like limited surroundings. No request is made for unseemly wrangle with hair-split nicety of cube root, including the condition that the water-boy's name must be (a + b). But thanks will be due for information on 1,500 lb. and 3,000 lb. hammers concisely put into tabular form as the writer has done with the 2,000 lb. hammer, and which he believes to be a move in the right direction.

This letter owes its existence to the encouragements given in Mr. HERING'S remarks on "the factor of safety" (page 8 "Bearing Piles"), where his sound "horse-sense" inspires him to assert that much depends on the "judgment of the engineer". Yours respectfully,

F. P. K.

### Form of Field Notes.

TAZEWELL C. H., Va., Oct. 8, 1888.

EDITOR ENGINEERING NEWS:—

I am very much pleased with your decided preference for the method of keeping transits notes lately brought into prominence by Mr. BURGESS. I have used this system for a long time, and have been its earnest champion and advocate on all occasions. It certainly is the acme of simplicity compared with any other, and I trust will, with the wide celebrity given it by your valuable journal, it will hereafter be given a place in the new edition of all engineers field-books.

Valuable as it is on location, it is doubly so on construction work, where the same curves have to be re-run repeatedly in giving centers. As it is also desirable to have the elevation of the ground and grade in connection with the alignment, I use the following form in my practice. You will notice that five columns are used, while the ordinary transit book contains 6. The extra one is as useless as the fifth wheel to a wagon, a vagary introduced in the dim past by some dealer in engineering materials and blindly adhered to ever since. The extra column lessens the width of the others materially, making the crowding of figures necessary. As a digression, I think the *proper form of field books* would form a very proper subject for discussion.

| Station. | O. | Defl'tions & Courses. | Elevations. Ground. | Grade. |
|---|---|---|---|---|
| 14 | | c. c. N. 10°12' W | 2019.1 | 2021.0 |
| 13 | | M.C.N.10°10' W | 2018.6 | 2020.0 |
| 12 | P. T | 8° | 2015.4 | 2019.0 |
| 11 | | 6° | 2016.0 | 2018.0 |
| 10 | | 4° | 2018.5 | 2017.0 |
| 9 | | 2° | 2020.0 | 2016.0 |
| 8 | P. C. | { 16° / 4° R | | |

The notes start at the beginning of a residency and run continuously to the end, always reading from *the bottom to the top* of the page. The

right hand pages are reserved for reference points' bench marks, property lines, etc.

The resident engineer is thus equipped with the alignment, level, grade and other notes of his residency contained in the smallest possible compass, and is not under the necessity of calculating deflections and grades every time he is asked to give them when passing over his work.

Much valuable time otherwise spent in computation (I was about to add, under a convenient shade tree, but as that proverbial chestnut has done duty so often, it is time that it was laid upon the shelf, and a great deal more can be saved if large plugs, solidly driven and carefully centered, are placed at about 200 ft. intervals, which will obviate the necessity of re-running the curve from the P. C. when the line ahead is next required.

Referring to your remarks on the method of obtaining the areas of irregular cross sections by means of the planimeter, it is undoubtedly the most correct, especially if the computer should not be very well versed in the science of trigonometry, a not unusual occurrence. But I suppose there is not one railroad engineer office in a hundred that contains such an instrument, and this method will never prevail to any great extent while the abominable practice of plotting cross-sections in *books* obtains A far better plan is to take sheets of cross-section paper, cut the same into two parts, folding them in the middle. The cross-section paper being thin and flat, allows the free use of the planimeter. After the areas are computed, the sheets for each section can be placed together, a cover added, and all lightly stitched together on the center fold, and when doubled up they form a very convenient book, keeping the sheets clean and free from being misplaced or lost. EMILE LOW.

[It is generally, if not always, best to have a separate column for the computed and magnetic course. Otherwise the suggestions of this letter are good.—ED. ENG. NEWS.]

## The Fisher Bridge Joint and Improvements Thereon.

TRENTON, N. J., Oct. 10, 1888.

EDITOR ENGINEERING NEWS:

Mr. FOSTER'S "Improvement" on the Fisher bridge joint which is illustrated in your issue of Oct. 6, is mildly interesting, but a trifle too "subsequent."

The objection to the Fisher joint has been frequently suggested at first sight, that it requires a depression of the joint ties by so much as the thickness of the channel beam base-plate, about an inch. Actually this is of no consequence on ordinary roadbeds: the variation in thickness of different ties is often as great.

It occasions a slight inconvenience when laid on bridges, and elevated structures; in which case, of course, the upper surface of the tie under the joint must be cut down that depth. Impressed by this more than subsequent experience justified, I long since designed a modification of the Fisher bridge joint, for such cases, under name of the "skeleton" Fisher joint, a drawing of which I enclose.

A few of them, experimentally, have been in the main track for more than a year, on one of the heaviest traffic roads in the country. They were laid alternately with the regular Fisher joint to ascertain, by actual service, whether such a change would be of sufficient advantage, to advocate their general use.

The two side bars are really a special section of angle iron, with the rib on the lower side to allow turning the nuts of the U bolt. This rib is cut away on either end to permit flat bearing on the ties.

The cross bearing piece is bolted or riveted to the central part of these side bars, as shown, so as to bring their inner edges the same distance apart as the width of rail base, in this case, 4⅛ ins.

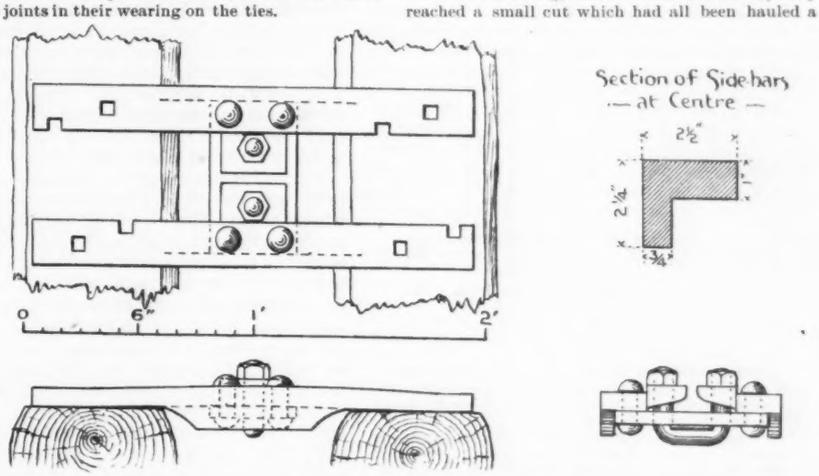
Both plans were tried: in one case the rivets were ¾ in. and in the other, ⅞ in., bolts and nuts were used, screwed down very hard.

The regular Fisher U-bolt and forelock, with the heavy elliptic spring underneath, are applied as shown. Two sets of spikes are in each end; one inside and against edge of rail base, the other through the ends of side bars, by which arrangement both the rails and the joint itself are maintained in alignment.

Properly proportioned, it weighs a little less than the Fisher regular joint. It is simple, easily made, and costs something less. But, as you correctly surmise, it is inferior to it.

The result of over eighteen months' trial fully justifies your "damning with faint praise" this "improvement" which Mr. FOSTER apparently imagines is "new and nice". The Fisher joint, having one uniform surface varying in extent with the load by the flattening of its slightly elastic arch, also provides for the case of unequal settling of either tie by adjusting itself to that difference and is always secure. It is absolutely safe in case of a broken rail, which this one is not. The "skeleton" joint permits the rail to come down to the bare tie, after a short time, with "hammering" on the two ties alternately, quite as much as with the ordinary angle bar fastening.

It was found, too, that the *outer* side of the joint wore into the ties faster than the inner one; which still further complicates the action of both rails and joints in their wearing on the ties.




Fisher Bridge Joint—Skeleton Pattern.

Mr. FOSTER appears not yet to understand the principles of the Fisher joint, except in a vague sort of way. Its arched and slightly yielding construction is one of the most important. The rigid, or dead straight Fisher joint, was abandoned long since for some of the identical defects which a trial of this "improvement" develops. But even without that, any one experienced in such matters should readily see that such an arrangement will fail, because it is impracticable to have a *mixed* support for rail ends sometimes on the rigid metal bearing at its extremity, and again on one or both of the wooden ties adjacent. They will not act together, and hammering, with "low" joint ties, is the result just as with angle-bars.

From the illustration it would appear that Mr. FOSTER'S "improvement" is intended to be *cast* of steel or iron.

It may be further mentioned that in those I have had in track for so long, there was, in a few instances, a slight loosening of the rivets, but those put together with the ⅞ in. bolts remained solidly together. CLARK FISHER.

## Needless Earthwork Refinements.

DENVER, Col., Sept. 25, 1888.

EDITOR ENGINEERING NEWS:

In your last issue you touch upon a subject which has come up to me very often. There are about three "wastes of labor" which the average graduate has to unlearn, "prismoidal correction," "vertical curve" formulæ and some fine spun scheme for computing haul.

On the Cheyenne & Northern branch of the Union Pacific Ry., one engineer, who had no cut of over 5 ft. and no fill greater than 6 ft., figured every quantity by the prismoidal formulæ, and entirely overlooked any allowance for shrinkage.

Another, on the same line, where free haul limit was 1,000 ft., insisted that this meant the fill joining the mouth of the cut should be made from the earth 1,000 ft. in, the second from that 900 ft. in, etc., or that a thousand feet should be made on each yard.

But this is a question about the rights of which few agree. A common method in Colorado, where the free haul has usually been 100 ft., and where material was estimated as hauled until price of excavation and haul equaled waste and borrow, has been to get the distance where haul ended, and find the distance you went into the cut and distance into the fill, which can be ascertained with one or two trials, then find what distance from half of this cut was the line of half the excavation and what distance of half the fill, the difference between these two points being the average haul; 100 ft. of free haul being subtracted from this gives the overhaul, and this by the number of yards in the cut gives the yards of overhaul.

I had an amusing incident happen under my notice at one time in regard to haul. The head officer had become somewhat suspicious, and had sent out a "commission" to examine our work. The "commission" was composed of two "Expert Engineers", and they had worked three days and had unearthed nothing, when on the fourth day they reached a small cut which had all been hauled a considerable distance on account of there being no suitable material to borrow to make the fill. A severe look came over the brows of expert No. 2 as he scanned the estimate sheet and eyed the cut. He gazed with sorrow on the poor Resident and asked, "How is this? There are less than 3,000 yds. of material of all classes estimated in this cut, and yet you have here estimated the contractor nearly 6,000 yds. of haul", and his lips closed tightly to show his sorrow for the unfortunate Resident, who answered in even tones that, "It might have been 6,000 yds. moved 100 ft., or 3,000 yds. moved 200 ft., but it *was* 2,000 yds. moved 300 ft. beyond haul limit."

Are you certain that the "Kansas method" of "paying both ways" is an unmixed good? Where material is Kansas "dirt" and Residents are to be spread over a long division which is to be finished as quickly as possible, it is probably best; but on the line of the D. T. & Ft. W. Ry., last year I saw an instance where it was a hardship. In a portion of the line crossing the Ratoon Mountains, there was a long fill, and the dirt on the sides looked all right; but on attempting to work it but one plowing could be taken off when they got among a mass of lava rocks, and it became necessary to haul the material a long distance and as the road paid for no haul the contractor suffered a severe loss. Where haul is paid it protects a man when he has to move borrowed material a long distance.

On the line of the F. E. & M. V. Ry., into the Black Hills there arose a dispute between the Resident on a certain division, and one of his contractors regarding the proper classification of a certain cut. When the chief engineer came over the line his attention was called to it. He asked the Resident if he did not think it should be loose rock. Resident replied: "I am not very familiar with the nature of loose rock." He was certainly more honest than the other fellow who insisted that a cut of soft Wyoming sandstone must be either earth or solid rock, "from the nature of it, it cannot be loose rock." Yours truly,

A. M. VAN AUKEN.

A HEAVY freight train ran off the derailing switches at Bridgeport, Conn., Oct. 25, disregarding signals, and was wrecked, but saved from the river.

# ENGINEERING NEWS
AND AMERICAN RAILWAY JOURNAL

*Published Weekly at Tribune Building, New York.*

**VOL. XX. Saturday, October 27, 1888.**

D. McN. STAUFFER, A. M. WELLINGTON. EDITORS.

GEO. H. FROST. - - - - - BUSINESS MANAGER.

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**Coming Technical Meetings.**

**Engineers' Club, Philadelphia, Pa.**—Regular meeting, Nov. 3. Secy., Howard Murphy, 1122 Girard St.

**Civil Engineers' Society of St. Paul, Minn.** — Regular meeting, Nov. 5. Secy., Geo. L. Wilson, City Hall.

**Engineers' Club of Kansas City, Mo.**—Regular meeting, Nov. 5. "Electrical Railways", T. F. Wynne. Secy., Kenneth Allen, Y.M.C.A. Building.

**American Society of Civil Engineers, New York.**—Regular meeting, Nov. 7. "Report of Committee on the proper Relation to each other of the Sections of Railway Wheels and Rails." Secy., John Bogart, 127 E. 23d St.

**Western Society of Engineers.**—Regular meeting, Nov. 7. Secy., L. E. Cooley, 171 La Salle St., Chicago.

**Civil Engineers' Club of Cleveland, O.**—Regular meeting, Nov. 13. Report on Mechanical Engineering. Secy., James Ritchie. Case Library Rooms.

**National Association of Brickmakers.**—Annual meeting at Memphis, Tenn., Nov. 13, 14, 15.

**Engineers' Society of Western Pennsylvania, Pittsburg, Pa.**—Regular meeting, Nov. 20. Secy., S. M. Wickersham, Penn Building.

**Boston Society of Civil Engineers, Boston, Mass.**—Regular meeting, Nov. 21. Secy., S. E. Tinkham, City Hall.

THE nominations for officers of the American Society of Civil Engineers have been announced in advance this year by a special circular, the first time, we believe, that this has ever been done. They include four non-resident members, all of whom are new to the Board of Direction, Messrs. M. J. BECKER, of Pittsburg, Pa., for President; E. L. CORTHELL, of Chicago, Ill., for Vice President, and ELIOT C. CLARKE, of Boston, and ROBT. E. MCMATH, of St. Louis, for Directors. Two resident members are also new to the Board, Messrs. WALTER KATTE and W. P. SHINN; two others have served one year each as Directors, Messrs. A. FTELEY, for Vice President and CHAS. B. BRUSH, and two, the Secretary and the Treasurer, are officers of many years' standing.

We think it is unfortunate that there is neither law nor custom to establish some kind of gradation in the nomination for offices by which it should be necessary that a man should have been director before he is eligible for Vice President, and Vice President before he is eligible for President. He would then have the advantage of some familiarity with the affairs of the Society before he was elected to the higher office. Last year, for example, Mr. ROBERT MOORE, of St. Louis, was elected Vice President. He had never before been a director and he now drops altogether from the ballot list, Mr. ROBT. E. MCMATH, of St. Louis, taking his place, and doubtless he also for only one year. No less than 38 directors have held office for only one year, against 11 for two years, 5 for three years, and 8 only for four or five years, out of 63 who have held that office, most of the long terms having been in the early days of the Society. Of the Vice Presidents since 1880, 7 have held office for only one year, and no one of them have been promoted to President, 3 have held office for 2 years, with 2 promotions, and 2 have held office for three years with no promotion. The tendency is to make the offices of President and Vice President purely ornamental ones, which is perhaps gratifying to aspirants for future vacancies in those offices, but hardly for the good of the Society.

A BILL for a Hudson River bridge at New York has been introduced in Congress, conferring upon Messrs. RUFUS HATCH, HUGH R. GARDEN, EGBERT L. VIELE, and five other gentlemen equally unknown to fame as engineers, and their associates and successors, the right to erect, maintain, and operate such a bridge, with suitable approaches. The proposed bridge shall be constructed with a single span over the entire river between the pier lines, and at least 142 ft. above high water.

There is no chance now that the bill will pass until next session, and it is preëminently one which should never pass at all, until these gentlemen can show either that they have the money in hand to build the bridge or a plan in hand by which they could build the bridge if they had the money, or an engineer connected with them who might be supposed capable of forming a plan, or of judging of one prepared by others At present they have no one of these proper requirements, and the legislation they seek therefore belongs merely to that highly objectionable class, in which rights to fulfill some plain necessity are sought "on spec", in the hope either that the wind may blow hereafter so that they can be utilized, or if not, that at least they may sell out to some one else, who finds prior franchises in the way of doing anything until they consent to a "divide."

MR. J. HERBERT SHEDD, engineer of the Providence water-works, writes us stating that these water-works began supplying water in 1871, whereas we only credit them as built in 1876 in our tables of two weeks ago. We should state that in our records of dates, whenever the construction extended over more than one year, we have taken the latest date, of the completion of the works, as the "date of construction", as is obviously proper, since in most cases no water is supplied until the works are completed. Our record for the Providence works is, "Built in 1870-76 by city." It may be that these dates are wrong, and that the works proper were completed before 1876, the construction extending to that date being merely that process of extension of pipes which is never done; but the dates are such as were officially reported to us, and we presume the last date was that of the actual completion of the whole system, which in that case seems the proper date to classify the works under, although some water may have been delivered before. This same note will apply to a number of other water-works in other States of the Union.

THE fearful landslide in Italy comes in to reinforce what we said last week in connection with the break in the West Point tunnel, that tremors of the train greatly add to the instability of, and danger from shaky material in railway works. A terrific land slide fell just at the very second required to overwhelm a train, and cause a slaughter of perhaps 200 out of 400 in the train. It is of course a possibility that its falling just at that instant when the train was under it was a coincidence and not the result of cause and effect. But as the traffic on this road is light, and as there are 86,400 seconds in a day in any one of which it might have fallen, the chances are at least a thousand to one that the passage of the train had something to do with the initial motion of the mass. It may have been trembling in the balance for several days, but there must always be a last straw to start such a catastrophe, and the tremor of a train is the best of all straws for such a purpose.

In the meantime it is reported that the break in the West Point tunnel is going to prove a more serious matter to repair than was expected, owing to the fact that the whole surrounding material appears to have been shaken up, and the work of removing what had fallen is extremely likely to start worse falls. The repairs may possibly cost more than the tunnel itself before they are done with.

THE crossing war in Manitoba is running the same disgraceful course of violence that many other crossing wars have done, and seem to have a peculiar tendency to do, but with the unusual variation that the Provincial Government itself is taking a hand in it. There seems to be some reason on both sides, but the fact of special significance is the small hold on either the respect or affection of the Province which the Dominion Government seems to enjoy. Such contumacy by one of our States would be impossible.

IN the late discussion on Universal Time, before the British Association, it was apparent that national jealousy has much to do with the failure as yet to fix upon an initial meridian. The Washington Conference of 1884 recommended the adoption of the Greenwich meridian, but the French delegates refused to concur. The Bologna Academy now proposes to settle the question of location by urging the adoption of a meridian passing through Jerusalem or some neutral point that would not slight any national prejudice! While such a neutral meridian might do, as a last resort, the position of France, or that of any other nation objecting to Greenwich as a starting point, is a very absurd one. England, to commence with, controls the bulk of the commerce of the world and has made most of the maritime charts, and if any nation has "a right" to locate such a meridian within its borders, Great Britain has this right. But on the other hand, the value of such a right is purely sentimental; it does not make a nation a jot richer or stronger, and gives it no commercial or national advantage. Such a meridian is merely an imaginary line, a point of departure, and as long as its location is one generally recognized and understood, the benefits of such an initial meridian are common to all commercial nations, whether the line itself is supposed to be in England, in France or in Jerusalem. The unification of time is a matter of as much importance to astronomers as it is to sailors, and any delay in its general adoption on such petty grounds of difference as that of location is ridiculous and discreditable.

M. DE LESSEPS has again assumed the role of a prophet, and some day as yet unfixed in July, 1890, is to see the opening of the canal, according to his latest views. M. DE LESSEPS is now 84 years old, and on that account is entitled to a charitable interpretation of his motives, which otherwise would admit of only the darkest interpretation, since there is no shadow of chance that the canal will be opened at any, such date. The excavations apart from the locks, are now almost at a stand-still, and nothing at all is being done toward the control of the Chagres.

In the meantime there is a possibility which

may assume early importance, suggested by the beginning of work on the Chignecto ship railway, that the ultimate end of the works so far executed will be as adjuncts to a ship railway. We have reason to believe that this is distinctly kept in mind by the principals in that enterprise, and surely a better place for a first experiment could not be found than at Chignecto. There is at Panama about 15 miles of completed canal through the flats on the Atlantic side which could be utilized as an approach to a ship railway, and while much of the grading already done would be thrown away, from defects of line or level, there would doubtless be enough of it available to materially reduce the cost of grading for a railway, if it were nothing but the work at Culebra. The alignment is objectionably crooked for a ship railway, but we shall not be surprised if the plan should be ere long actively agitated, and we have never hesitated to express the conviction that it is, in our judgment, entirely practicable to arrange for the safe and speedy transportation of the largest ships by rail. If the Nicaragua canal be started in the meantime, however, as we think is probable, the chances for the ship railway attempt will be much less.

THE immediate obstacle in the way of the Nicaragua canal is the lack of a national charter, which is justly felt to be almost an essential to the advantageous placing of bonds and conduct of the work. The bill to incorporate the company (nothing more is asked) passed the Senate by a very large majority in the last session, and failed to pass the House only because there were two or three objectors to raise the point of "no quorum", but it can hardly fail to pass by a large majority when it is brought up in the House at the next session with a quorum present. Should it by any chance fail, we understand it is the intent to organize and proceed with work under a State charter, and we have reason to believe that in either case, there is not likely to be any difficulty in raising the necessary funds, although on less favorable terms with a State charter only.

WE have received quite a number of communications, giving various ways of determining over-haul, one and all of which we have been obliged to decline, for the reason that we really cannot perceive that any of them show any method better or simpler than that which we outlined two weeks ago, viz., to plot the volume of each section as an ordinate on a base line on which horizontal distances are laid off as abscissas, or in the same manner as center-heights are plotted to make a profile; cut out the area thus constructed, and determine its center of gravity mechanically; the part at each end included by the free haul stipulations being neglected, and the dividing line between haul to or from each direction being first determined in the usual simple manner by successive additions of the volumes of the computed solids until the required total to equal a given cut or fill (keeping in mind the proper allowance for shrinkage) has been obtained. As we previously stated, any attempt at mathematical exactitude is usually out of place in determining this allowance, and in our judgment it is nearly always much better to make no allowance for it at all, but to require comparative hauls to be estimated by the contractor in advance and allowed for in his bid. It would even be simpler, and leave less chance for error and dispute, to fix separate prices for separate cuts of any size, in many cases.

IN most of the foreign text-books of engineering, and in some of the American, elaborate methods for computing the average haul and over-haul are given, and if absolute exactitude be required, a good deal of mathematics can be used in determining it. Even when less precision is attempted, a variety of graphical and other methods can be devised, three of which, each differing slightly from the other, have been sent in, but the problem is so simple that it hardly seems to us necessary to give more than the above hint as to the proper method. A little ordinary ingenuity will enable anyone to determine by its aid the proper overhaul allowance within a few feet, and more than this does not seem to us worth while.

## Train and Air Resistance.

We republished in our issue of Oct. 6, an editorial from *The Engineer* discussing our editorial of Sept. 1, under the above head, which justifies further comment, some of its statements as to this still obscure subject being of much interest, and some of them such as should not go uncorrected.

We may begin by a few words in regard to the closing sentence of our contemporary's article, which was as follows:

"The statement with which our contemporary concludes is so remarkable that we cannot comment on it until we are sure that we understand it aright. It is that at high speeds the internal resistances of a locomotive engine amount to more than 50 per cent. of the total power exerted—that is to say, an engine indicating 500 H. P. at 60 miles an hour only expends 250 H. P. in drawing the train. Such a remarkable proposition as this requires careful propping with selected facts. Is it too much to ask our contemporary to let us have a few?"

*The Engineer*'s reserve is judicious, for what we said was not that the "internal resistances," in the usual sense, of the locomotive engine amounted to these large figures, but that "the disproportion between the indicated and transmitted horse-power" or the "power transmitted back of the engine to the cars" amounted to this aggregate at high speed, while there was a very slight disproportion at low speeds. This statement is indisputably true, and we are astonished that it should be questioned, if it was in fact intended to question it. Among many other evidences may be mentioned the following:

MR. P. H. DUDLEY, in a combined dynamometer and indicator test of a fast New York Central passenger train of 9 cars and 313 tons total weight, obtained results which generalize as follows:*

| | Av. H. P. expended on— | | | |
|---|---|---|---|---|
| Av. speed, miles per hr., 51.43 | Train 340 lbs. | Engine 429 lbs. | Total 766 lbs. | P.c eng. 55.61 |
| Equivalent total traction resistance | 2.479 | 3.106 | 5.585 (= 1/9 adhesion). | |
| Ditto, in lbs. per ton | 9.92 | 49.25 | 17.8 | |

"This is a considerably lower total resistance per ton for the entire train than accepted formulæ indicate, which is about 30 lbs. per ton. Mr. Dudley's engine and head resistance, as an average of all his records (not all given here), amounts *per engine* to $0.83V^2$ lb. Tests made by Mr. WELLINGTON give a somewhat smaller result for the engine resistances, viz.:

| | lbs. per engine. |
|---|---|
| For head resistance | $0.28V^2$ |
| For oscillation and concussion | $0.35V^2$ |
| = Total | $0.63V^2 + 4$ to 8 lbs. per ton constant." |

In *Annales des Ponts et Chaussées*, May, 1886, some tests by M. DESDOINT are given in full with accompanying diagrams from which it appears that at 50 miles per hour the engine alone absorbs over 60 per cent. of the resistance although followed by a train of 200 tons behind it. In another paper in the *Annales*, by M. RICOUR, September, 1885, we have the engine given as absorbing 65½ per cent. of the power at 50 miles per hour. *The Engineer* itself states, April 4, 1884, and very justly, that it is "a figure accepted with locomotive superintendents" that the resistance at 60 miles per hour is about 40 lbs. per ton with a train of 336 tons, which requires that fully the above proportion should be due to engine head resistances only, for it is a fact now well established that the resistance of the train *behind the engine* does not increase much with speed, if indeed it does at all, which is disputed. One French formula gives in metric units for the train behind the engine

$$R = 2 + \frac{v}{40}$$

which for a speed of 80 kilos. per hour (about 50 miles) gives 8 lbs. per ton for the train, against 6 lbs. at half the speed.

On the other hand—and here is where we suspect *The Engineer* has got its impressions—MR. WM. STROUDLEY, the able and painstaking Mechanical Superintendent of the London, Brighton & South Coast Railway, read a paper (*Trans. Inst. C. E.* 1885) giving results of a notable test run of 50.4 miles at 43.3 miles per hour average, without a stop, in which he reports two remarkable and entirely inadmissible results: *First*, that he only averaged 529 H. P. indicated power, and *transmitted all of it* but one H.P., (or 528 H.P. in all) back through the draw-bar to the train; and *secondly*, that he only burned 2.03 lbs. of coal per indicated H. P., a marvelous result, based solely on the consumption of 1,200 lbs. of coal in all or about 1.2 cu. ft. per sq. ft. of grate. The last is far too tall a fabric of deduction to base on such small quantities: it is plainly a matter of figuring and allowances. The first is so extreme a claim that it disproves itself; there were plainly uneliminated sources of error in the tests, for as the engine and tender weighed $\frac{4}{13}$ of the whole train, or 20 per cent., there should have been a difference of 20 per cent. at least in the indicated and transmitted power, even had there been no head resistance whatever, or excess of frictional resistances per ton in the engine.

So much for the fact, which we take to be indisputable, that at high speeds fully 50 per cent. of the developed power is destroyed within the engine itself and never passes back of the tender. It remains to consider how much of this can be accounted for as air resistance.

It appears to be an historical fact that at a very early date in the history of railways the advantage of giving a certain prow-shaped form to the head of trains was suggested and experimented on. Dr. LARDNER, in the experiments we re-quoted from *The Engineer*, found that the form of the train (or other body passing through the air presumably) had no effect, but that it was a mere question of bulk. Recently the idea of the prow has been revived and experimented on in France, with results said to show a decided gain, of something like 10 per cent., but not, we think, in a conclusive manner.

That Dr. LARDNER's theory that it is a mere question of bulk is not tenable, seems to be proved by the facts mentioned in our last article, that the velocity resistances of loaded and empty box cars, which have the same bulk, are very nearly (not quite, but nearly) the same *per ton*, i. e. the total velocity resistance in pounds per car is much more than doubled by putting 20 tons of load inside a 10-ton car, instead of remaining constant, as it would under the atmospheric bulk theory. *The Engineer* now advances the further theory that form is of no importance, for reasons which we will give in its own words, italicizing some of special significance.

"Let us see whether it is or is not reasonable to suppose that a prow would prove useful. It is naturally suggested because the bows of a ship are made sharp to

*The data as to all the tests here mentioned and various others may be found more fully given in "The Economic Theory of the Location of Railways", p. 320 *et seq.*

facilitate her passage through the water. But there is reason to think that the analogy between water and air is strained. The work done by the train in passing through an elastic medium like air is diverse from that done by a ship in passing through water, a non-elastic medium. The resistance of the air may be regarded as so much pressure on each square foot of surface. It is a mathematical truth that the total driving force on a piston is independent of the shape of the piston face. *** Many years ago an ingenious individual, ignorant of mathematics, patented a corrugated piston. The actual superfices of such a piston was, of course, much larger than that of a plain piston, and he took it for granted that a corrugated piston 12 in. in diameter would be equal to an ordinary piston of 18 in. in diameter, and that he would thereby effect an enormous saving in steam. He did not know that the pressure of a fluid on a pyramid is measured by the area of its base and not by its superfices. Now it appears to us that it is quite as great an error in the opposite direction to assume that if we fit the leading end of a locomotive with a cone the retarding pressure will be reduced. *If the resistance is caused by pressure, then the form of the body driven through the air can have no effect, unless it can be shown that the cone really reduces pressure.* Let us fit a locomotive with a flat windboard 14 ft. high and 10 ft. wide. The gross pressure on it would be, at 60 miles an hour, say, 140×35 =4,900 lbs. If we fit on a prow having the same sectional area of base, the resistance to the advance of the train must continue to be 4,900 lbs., unless the pressure per square foot is in some way reduced below 35 lbs. Whether this is or is not possible we do not know. *We do know that there are very good reasons why it should not be reduced.* Possibly our contemporary can advance yet better reasons why it should be reduced, and we shall be glad to hear them. Arguments based on a ship will, however, not do. The notion that a sharp bow facilitates the passage of a ship through the water is extremely crude—a relic of the past. The resistance to a ship depends not on the form of her bow alone, but of her whole body. A sharp bow is merely an accidental concomitant of a great deal more."

It needs but a moment's reflection to perceive that there is no analogy between the case of a piston driven through a close cylinder where there is no opportunity for the air or other fluid to escape at the side, and the case of any body whatever passing by displacement through a surrounding fluid of practically limitless volume, where the whole resistance arises from the work of displacement alone. It is true that air is an elastic and water a non-elastic fluid, which unquestionably modifies the laws of resistance; but all the evidence, and there is a great deal of it, as to the resistance of bodies passing through either is that other things being equal the resistance is about as the square of the velocity; and that form does have a most important effect on the resistance of the air against the same surface is proved as neatly as by anything by the common anemometer, which is caused to whirl with great rapidity in the lightest breeze simply by the difference in the resistance on the convex and concave side of the same cups.

If our contemporary is correct in its confident declaration: "We do know very good reasons why it (air resistance) should not be reduced by form", we should be pleased to see and to consider some of those good reasons. Certainly it advances none in its articles, except the piston-and-cylinder comparison, which we have seen to be utterly irrelevant, and the strange declaration that "the notion that a sharp bow facilitates the passage of a ship through the water is extremely crude." That was the view of English shipbuilders, we believe, half a century ago; but the Baltimore clippers were not laid down on that principle, and the lesson that they taught in naval architecture has since been accepted by the world, all fast steamers having sharp bows, not as an "accidental concomitant" but as the first essential, none the less so because it requires a sharp and well shaped stern and proper cross-section as well.

The important point, be it remembered, is not whether prow-shaped locomotives would diminish train resistance, which may or may not be so, but is hardly likely to be very "important if true", but whether the undeniably great increase of resistance with speed comes from air resistance only or very largely from oscillation and concussion; in other words, whether the slight effect of change of form which Dr. LARDNER observed, came only or chiefly from the fact that form made little *difference* in the air resistance, or from the fact that the *total* air resistance is only a small factor in the aggregate velocity resistance. On a correct answer to this question may hang important practical conclusions. We have stated several facts with which Dr. LARDNER'S conclusions are irreconcileable, while all the facts which he can be regarded as having established are reconcileable with the opposite theory, which fits all the facts so far determined.

*The Engineer* adds two interesting facts to the discussion, in the following words:

"BEAUFOY'S experiments showed that if an equilateral triangle be towed through the water, base first or point first, the resistance is least in the former case. There are besides certain phenomena about the action of a train on air which resemble nothing seen at sea. Thus, for example, when a train is moving at a high speed, there is a powerful current of air rushing in the opposite direction at each side of the train. On the Caledonian Railway, north of Carlisle, aspen and birch trees grow in some places quite close to the line. The flying express last August consisted of four coaches. Sitting in the next coach but one to the engine, it was easy to see as the train tore past the trees at over 60 miles an hour that they were powerfully blown back by a fierce wind, set up by the passage of the train. Before we saw this, if we had been asked an obvious question on the subject, we should have replied that the train would carry a body of air forward with it, which would cause the trees to bend forward in the direction which the train was taking. That answer would have been wrong. Those who have stood on the platforms of stations as the train ran through at high speed, say that it was followed by a perfect tornado which scattered sand, dust, and even little stones in the wake of the train. It is clear that the bulk of a train must have a powerful effect, acting, as it does, as a displacer."

Col. BEAUFOY'S experiments are now somewhat ancient, were on a small scale, and covered such possibilities of error that we do not consider that he "showed" anything of the kind. It is one of the painful lessons which successful investigators have to learn early, that all such unsupported allegations have to be taken with many grains of salt. To illustrate: Mr. D. K. CLARK, a very competent authority, quotes with approval in his "Manual for Mechanical Engineers" p. 897, experiments by Mr. JAS. C. FAIRWEATHER, another presumably competent authority, which show the following interesting results for air resistance. We transform the table only by changing lbs. of total resistance for speeds in ft. per second into lbs. per sq. ft. of area for speeds in miles per hour, at the rate of 15 ft. per sec. =10 miles per hour:

| Side of square ins. | Area square ft. | Resistance in lbs. per sq. ft. at speeds in miles per hour. | | | | |
|---|---|---|---|---|---|---|
| | | 3⅓ | 6⅔ | 10 | 13⅓ | 20 |
| 7.41 | 0.38 | 1.45 | 3.68 | 8.55 | 15.00 | 36.8 |
| 12.9 | 1.155 | 1.22 | 4.75 | 11.8 | —— | —— |
| 18.58 | 2.40 | 1.35 | 6.25 | —— | —— | —— |
| diam. of circle | | | | | | |
| 7.24 | 0.286 | 1.05 | 4.02 | 9.08 | 16.10 | 38.0 |
| 12.65 | 0.875 | 0.97 | 4.40 | 10.40 | 18.70 | —— |
| 18.36 | 1.840 | 1.31 | 5.44 | —— | —— | —— |

There is just enough irregularity in this table to inspire confidence in it; it comes highly vouched for, we have lighted on it purely by accident in hunting up what authority might justly be ascribed to Col. BEAUFOY,—and it is absolute nonsense. It indicates in the clearest manner (1) that resistance per square foot increases rapidly with area, (2) that it increases much more rapidly than the square of the speed, and (3) that resistance is from 20 to 40 times SMEATON'S heretofore accepted formula (which is unquestionably too large for large surfaces) of $0.005\ v^2$ in miles per hour. We are half inclined to think that Mr. CLARK made a mistake of one place in his decimal point, giving ten times too high resistance, although we see no evidence of it; but even then, the allegations of the above table when cut down to one-tenth remain wholly inadmissible.

It is therefore pertinent to remark that, in spite of Col. BEAUFOY, it is a well established fact that a cone of height equal to its diameter opposes about 2½ times as much resistance to air with the base forward as with the point forward; that the resistance of a hemisphere in the air, convex side forward, differs but little from that of the complete sphere; and a few other facts like these for which we have left no space.

The other fact mentioned above is certainly an interesting one, that at very high speeds the lateral currents near the middle of the train are backward. We have never observed it. It simply goes to prove, however, that the train pushes ahead a large volume of air, leaving a vacuum behind, and that the air rushes in from all directions to fill it. At the rear of all fast trains there is a powerful following current. So far as it goes this fact seems to prove that anything which diminishes the bulk of air pushed ahead in front of the train would diminish the atmospheric disturbance at side and rear. It tends to support an allegation of a writer in the *Railway Review* of Chicago, who seems to have some familiarity with dynamometer work, that at very high speeds the resistances of the rear cars tend to increase very slowly if at all.

The main conclusion which seems to be indicated by all the facts so far brought out, we repeat, is that which we set out to establish, that atmospheric resistance is not by any means the only, nor the chief cause of velocity train resistance.

### Consolidating Southern Railway Systems.

The greatest and most important consolidation of railroad systems which has taken place for many months has been consummated this week in Wall Street. The Richmond & West Point Terminal Company has secured a controlling interest in the stock of the Central Railroad & Banking Company of Georgia, and has added thus to its own system, 4,500 miles in extent, a system with a mileage of over 2,500 miles, making a total of over 7,000 miles and thus outranking in its mileage of main tracks the great systems west of the Mississippi and the trunk line systems.

The Richmond & West Point Terminal Company was chartered eight years ago, in the interest of the Richmond & Danville Railroad Company, for the purpose of acquiring control of tributary and competing lines of railway; and it has increased the Richmond & Danville system from an extent of 450 miles in 1880 to over 4,500 miles prior to the deal just announced. The principal subsidiary systems which make up this 4,500 miles, are the Richmond & Danville, 858 miles; the Virginia Midland, 413 miles; the Charlotte, Columbia & Augusta, Columbia & Greenville, and Western North Carolina roads, 959 miles; the Georgia Pacific, 401 miles; and the East Tennessee, Virginia & Georgia system, a long lease of which has just taken place of the control held through the ownership of preferred stock, 1,603 miles.

The northern terminus of the system is at Washington, D. C. It reaches the sea coast at West Point, on Chesapeake bay, Brunswick, Ga., and Mobile, Ala., and is building a road to and erecting terminals at Norfolk, Va. The main line runs to Atlanta, Ga., and from this point the Georgia Pacific extends due west *via*

Birmingham, Ala., and is under construction to the Mississippi river at Greenville, Miss., to be completed within a few weeks. Other important points reached in the South are Lynchburg and Danville, Va., Greensboro, Raleigh, Asheville, and Goldsboro, N. C., Knoxville, Chattanooga, and Memphis, Tenn., Columbia, S. C., and Augusta, Ga. By its new acquisition, the company obtains two additional seacoast terminals, at Port Royal, N. C., and Savannah, Ga., and reaches all important points in central Georgia and eastern Alabama. Better than this, however, is the fact that its purchase is a valuable piece of property, which earns good dividends now and has every prospect of earning larger ones in the future.

The manner in which the control was obtained of the Central of Georgia system presents an instructive lesson in the profits of railway financiering.

About 18 months ago a corporation known as the Georgia company was formed by a half dozen New York capitalists for the purpose of uniting under one control a majority of stock of the Central Railroad & Banking Co., of Georgia, and $4,000,000 of the stock was secured. On this four millions of stock as a basis, the syndicate of capitalists composing the Georgia company issued four millions of bonds and *twelve millions* of stock. The bonds were sold, and it is supposed that the syndicate received for them nearly or quite as much as the original amount of cash which they had expended for the railroad company's stock. The $12,000,000 of stock has been held, and it is this stock which has been sold to the Richmond & West Point Terminal company for $35 per share in cash. Thus the gross receipts of the half dozen capitalists who composed the Georgia company, from their year and a half of financiering, are $4,200,000, which is nearly all clear profit.

Much is being said of the supposed injurious effect of the deal on the Norfolk & Western Company, which has been competing with the Richmond Terminal for the lease of the East Tennesee, Virginia & Georgia system. But it is an open question whether the gain from the control of the system would have been great enough to have made the lease a profitable one, bearing in mind the fact that the Norfolk & Western is soon to have direct access to all important points in Kentucky, Tennesee and Alabama through the connection soon to be made with the Louisville & Nashville system. Besides this the Norfolk & Western has its own terminus on the seacoast, and is the sole outlet to a market from the rapidly developing coal fields of western Virginia.

The effect of the consolidation in stopping competition and ending certain projects for parallel lines is very evident; but the extensive schemes for lines to develop unoccupied territory which President ALEXANDER of the Central of Georgia has developed, are likely to be pushed to completion no less rapidly than would have been the case had the consolidation not taken place.

## PERSONAL.

M. CHAMBERLAIN, Commissioner of Public Works, Providence, R. I., has been re-elected to that position.

L. T. KIMBALL has been appointed General Manager of the Union Pacific Railway system, and C. S. MILLER, Assistant General Manager.

C. P. BONNER, of the Norfolk & Western R. R., has been appointed Division Engineer in charge of the Cripple Creek extension of that line.

O. J. MARSTRAND, lately an engineer with the Phœnix Bridge Co., has been appointed Assistant Engineer of the Union Elevated Railroad in Brooklyn, N. Y.

WM. H. HOLCOMB has been appointed Vice-President and Chief Executive Officer of the Union Pacific Railway system, the place made vacant by the death of the late THOS. J. POTTER.

GEORGE H. JOHNSON, Sc. D., recently of the B. & M. R. R. R. in Nebraska, has accepted a position in the office of the Mississippi River Commission, 2,828 Washington Ave., St. Louis, Mo.

J.H. BARRETT, Superintendent of the Eastern division of the New York, Lake Erie & Western R. R., has been appointed Superintendent of Transportation. W. W. STEARNS, General Superintendent of the Central R. R. of New Jersey, will succeed Mr. Barrett.

W. H. PEDDLE, Chief Engineer of the New Jersey Central and Southern divisions of the Central R.R. of New Jersey, has been appointed General Superintendent of that system, to succeed W. W. STEARNS resigned.

J. C. S. TABER has been appointed Chief Engineer of the Pomeroy, Middleport & Syracuse Street Railway, a steam road, 10 miles in length, at Pomeroy, O. The New York office of the company is at Room 52, 44 Broadway.

J. A. L. WADDELL, Consulting Engineer of Kansas City, has had conferred upon him by the Emperor of Japan the order of the Rising Sun, with rank of Knight Commander, for "distinguished professional services rendered the Japanese Government."

P. F. BRENDLINGER, C. E., has been appointed Superintendent in entire charge of all the work of construction and repairs on the contract of BROWN, HOWARD & Co. on the New Croton Aqueduct, under the Receivership of WALSTON H. BROWN.

GASTON MESLIER, formerly of the Missouri Pacific, has been appointed General Passenger Agent, and A. S. DODGE, formerly of the Kansas City, Wyandotte & Northwestern, has been appointed General Freight Agent, of the Missouri, Kansas & Texas R. R.

GEO. C. DICKINSON, Civil Engineer, late of the Baltimore & Ohio Railroad, has been appointed Engineer in charge of the construction of the Hudson Suspension Bridge, now being built near Fort Montgomery by the Hudson Suspension Bridge & New England Railway Company.

C. C. PUDOR, Assistant Engineer of the Winona & St. Peter and Dakota Central divisions of the Chicago & Northwestern R. R., has been appointed engineer of the Madison division, with headquarters at Madison, Wis. HARRY BATTIN will succeed Mr. PUDOR, with headquarters at Winona, Minn.

Rev. JOHN HAGEN has been elected to the chair of astronomy, and director of the observatory of Georgetown University. Prof. HAGEN is a Jesuit, an eminent mathematician and a Member of the Royal Mathematical Society of Berlin. In conjunction with Prof. HOLDEN, now director of the Lick Observatory, he lately published revisions of the observations made by ARGELANDER many years ago, which are reduced for the use of astronomers.

EDWARD GALLUP, Assistant General Manager of the Lake Shore & Michigan Southern Ry., died at Cleveland, O., Oct. 22. Mr. GALLUP was born in Brooklyn, Conn., Aug. 20, 1842. He began his railway career in April, 1860, as Passenger Agent of the Ohio & Mississippi at Cincinnati. Afterward he became successively General Passenger Agent of the Kankakee Line, joint agent of Kankakee and Pittsburg, Cincinnati & St. Louis pool at Chicago; General Passenger Agent, Assistant General Superintendent, and General Superintendent of the Boston & Albany, and on Dec. 1, 1886, was appointed Assistant General Manager of the Lake Shore.

## The Canadian Pacific Railway.

IV.

The rapidity of construction noted two weeks ago will ever remain a remarkable example of the power of effective organization, aided by accumulated experience. The railway across the plains west of Winnipeg was hardly a surface line, averaging 17,000 cu. per yds. mile. Over 60 sub-contractors were at work and 300 separate contracts were let on the prairie section of nearly 1,000 miles; and as soon as each sub-contract was finished the force was jumped ahead 150 miles or so, being given a section which they could finish in about six weeks.

Two bridge gangs worked ahead of the track gang, their size varying with the number of structures to be erected, which was in general not large. Following them came the track gang consisting of 300 men and 35 teams. Progress for the whole first season, 1882, averaged 2⅓ miles per day, and in the last 42 days of the season, 3.19 miles. In 1883 there was laid:—

| | |
|---|---|
| April (18th to 30th) | 17.58 miles. |
| May | 51.97 " |
| June | 65.69 " |
| July (to Aug. 4) | 107.26 " |

The best single day was July 7, 6.02 miles, and the best week, that ending July 7, or 25.86 miles, 4.31 miles per day, the average of the 48 working days ending Aug. 4, having been 3.46 miles, all exclusive of sidings, which averaged 4 to 4½ per cent. of main line. This was by far the best record ever made up to that time, and although it has been exceeded since in some respects by the St. Paul, Minneapolis & Manitoba extension, yet considering all the relative difficulties it is doubtful if a more creditable record has ever been made to this day.

The track gang proper on the day of greatest work, and as a rule on all days, consisted of,—

| | No. of men. |
|---|---|
| Unloading rails from cars | 12 |
| Loading on trollies | 12 |
| Unloading and laying down rails | 24 |
| (8 men in all of these gangs were handling joints, bolts, etc.) | |
| Bolters | 15 |
| Spikers | 32 |
| Nippers | 4 |
| Peddlers (of spikes) Loading ties | 32 |
| Teams hauling ties | 33 |
| Unloading and distributing ties | 8 |
| Spacing ties | 4 |
| Readjusting displaced ties | 2 |
| Iron-car boys (6 horses) | 4 |
| total | 182 |

It took 1,600 bushels of oats per day, 2 car-loads of provisions, and 8 or 10 head of cattle per day to keep the whole force going, or in other words, required provisions to be on hand for 6,000 to 7,000 men stretched over 150 miles of country and constantly on the move, all being hauled on an average 1,000 or more miles by rail, and 50 to 75 miles by wagons. Admirable order was preserved, liquor being then and now entirely tabooed throughout this vast region, by laws which have had a good deal to do with the conspicuously good success of Canadian management of our Indian brethren.

The entire force employed during the period of active construction was about the same as in 1883, viz.: 7,000 in British Columbia, 9,000 in the central prairie section, 2,000 on the Government line from Winnipeg to Lake Superior, and 7,000 on the Eastern Division. Rightly considered, the progress made in this last named difficult section was even more remarkable than on the easier prairie work; but as it is impossible to understand the significance of the details of progress without an intimate knowledge of the work, more elaborate details than have been already given, need not be attempted.

### THE TRACK.

The track of the Canadian Pacific Railway is in general well laid and surfaced and in good condition. The joints are its weakest part. The rails through the mountain section are 72 lbs. per yd., but elsewhere chiefly 56 lbs., and they are laid with plain fish-plate joints, not angle bars. The track is also laid even joint throughout, in accordance with the all but universal custom in the Northwest, but in direct opposition to the prevailing tendency in the east and south. The practice is so nearly universal northwest of Chicago that we feel reluctant to condemn it unequivocally as bad practice, but it is difficult to ride over the whole length of the Canadian Pacific (and we may add, most of the western roads) without becoming convinced that it is bad practice. The road is well maintained; wherever ballast was to be had it is well ballasted, and throughout the mountain section it is superlatively well ballasted, there being an abundance of remarkably fine ballast on long stretches of the mountain work. Even across the plains, although there was no ballast to be had, yet the track is almost everywhere on embankment, and there is so little rain, and the material is so naturally suitable, that the lack of ballast is not seriously felt. The track compares very favorably throughout with that of the transcontinental roads to the South. The ties are abundant and well spaced. Nevertheless, 3,000 miles of the monotonous song, "chuck-a-chuck, chuck-a-chuck, chuck-a-chuck", varied only by an occasional reversion to "chuck-chuck-a, chuck-chuck-a, chuck-chuck a", would seem certain to produce an impression on the mind of the least attentive trackman that these perpetual blows must be pretty hard on the track, and if he should then take a much shorter ride over some piece of broken joint track and find, as he inevitably would,

that the noise at least was not half as great, he would find it hard to escape the conviction that the injury to the joint likewise was not very much more than half as great when the rails break joints as when the joints are opposite.

The problem of the joints is a very serious one on a road of thin traffic like the Canadian Pacific, far more so than on roads of heavier traffic which can afford to keep on the necessary force to keep the joints up continuously to a high standard. Whether the remedy be long three-tie angle-bars, or the Fisher joint, or any other type, it is evident that the present joints have not metal enough in them to effectively and permanently answer requirements. Long before the rails (which appear to be of excellent quality, and are standing well) are worn badly elsewhere, the joints will have degenerated into inadmissible condition, and this we take to be the general rule with roads similarly situated.

The switches on the road are nearly all stub; there are very few split switches on the line; but the frogs are of excellent make, and both frogs and switches are fully protected in the crotches by plank blocks to save men from the danger of catching their feet, which is peculiarly great in the Canadian climate, but which is a great one everywhere, and not always properly guarded against. A very sensible precaution on the prairie work, and elsewhere so far as possible, has been to throw off the side tracks 30 to 40 ft. from the main track in order to prevent the formation of snow drifts over the main track by cars standing on the siding.

ROLLING STOCK.

The standard locomotive of the Canadian Pacific is what has now become the locomotive builders' unit type, the 17 × 24 "American." Of these there are 246 in use, out of a total of 399 locomotives, the remainder consisting of 10 20×26 freight Consolidations; 10 Moguls; 11 18×24 Americans, 7 19×24 Consolidations for passenger use, and 115 engines smaller than 17×24, largely 16×24. Heavy snow-plows are used in winter on the locomotives, of 5-16 iron, double plated at nose, 5 ft. high at the nose and 7½ ft. high at the wings, clearing 9 ft. wide at the bottom and 10 ft. above. In addition there are the usual special snow-plows, of more than usual dimensions and power; but these are likely to be superseded by that admirable device, the Leslie rotary snow-plow, 12 of which are being built for the company; most of them to be in use this winter. But the Canadian Pacific has much less trouble from snow in proportion to other roads than is commonly imagined, and is likely to go through this winter with very little detention.

It is in its passenger equipment that the practice of the Canadian Pacific is most advanced in comparison with other roads, but notice of the passenger stock we must postpone.

(TO BE CONTINUED.)

THE Steamship *Atlas*, plying between New York and Costa Rica, was sunk in the North River by one of the ferry-boats of the Central Railroad of New Jersey, on one of the foggy afternoons of the past week. The accident occurred at about 4.30 P. M. and the ferry-boat was crowded with passengers, who were with difficulty restrained from leaping into the water in the panic which ensued after the collision. The ferry-boat had just put out from her slip, and was run back at once, but her damage was slight, as she struck the steamer squarely, bows on.

The steamer was moving up the river at half speed and the collision crushed such a hole in her side that she filled and sank in about four minutes. The crew of the steamer, which was a freight vessel, were saved by a tug. The pilots of each vessel claim to be blameless for the accident, and while it is stated that the *Atlas* was too near the shore, it is also alleged that the ferry-boat's engine was not reversed as quickly as it should have been. While the immediate cause of the accident is a matter of dispute, it is certain that the crowding of traffic on the North River at certain hours of the day is making the ferry transfer of many thousands of passengers across the river every hour a work of increasing hazard. A bridge or tunnel transfer will soon be demanded on the score of safety as well as convenience.

## PUBLICATIONS RECEIVED.

*The Elements of Electric Lighting, including Electric Generation, Measurement, Storage and Distribution.* By PHILIP ATKINSON, A. M., Ph. D., author of "Elements of Static Electricity". New York, D. Van Nostrand, Publisher. 1888. pp. 260, Illustrated.

While this work is hardly the "complete comprehensive treatise" on the subject of electric lighting partially claimed in the preface, for it would require volumes to make this claim literally good, it is a compact, concise treatment of the chief points essential for a general knowledge of the subject and its most improved details. Electric lighting has become so important a factor in our times that there is a demand for a work of the latter description and the author seems to have well met this demand. The work is profusely illustrated and the story is well told.

## SOCIETY PROCEEDINGS.

**Arkansas Society of Engineers, Architects and Surveyors.**—The second annual meeting of the Society will be held at Little Rock, on Nov. 22, 23 and 24, 1888.

An interesting programme will be prepared and it is hoped that a full attendance may be had, not only of members, but of all interested in the professions.

The following papers are promised:—

"Ft. Smith Sewerage System," by JAMES P. BATES, City Engineer, Ft. Smith, Ark.

"Little Rock: Its Municipal Improvements," by GEO. P. C. RUMBOUGH, formerly City Engineer, Little Rock, Ark.

"Water-Works of Texarkana," by A. B. MATSON, City Engineer.

"Water-Works of Rogers," by J. M. WHITHAM, Fayetteville, Ark.

"Highway Bridges (Howe and Queen Trusses)," by LEE TREADWELL, Fayetteville, Ark.

"Adaptability of the Various Kinds of Timber in Arkansas for Railway Purposes," by E. C. BUCHANAN, Little Rock, Ark,

"Concrete in Construction," by J. T. HOGANE, Texarkana, Ark.

"Proportionate Errors in Surveying," CHAS. W. STEWART, U. S. Asst. Engr., Amelia, Ark.

"What is Generally Expected of a Surveyor," by W. E. KEEFER, Hindsville, Ark.

"Description in Deeds," by B. S. WISE, Pangburn, Ark.

"Description in Deeds," by WM. MITCHELL, Prairie Grove.

"Design and Construction of Hydraulic Rams," by GEO. SCHOFF, Little Rock, Ark.

"The Uses of the Plane Table," by D. C. B. AIKIN, Fayetteville, Ark.

"Electric Lighting of Towns," by W. E. ANDERSON, Fayetteville, Ark.

Topical Discussion, by Members.

Papers are also promised by F. J. H. RICKON, F. W. GIBB, B. J. BARTLETT, of Little Rock, and A. WINSLOW, of the Arkansas Geological Survey.

All papers should be in the hands of the Board of Direction not later than Nov. 15, so that they may be classified and the reading arranged for each day of the meeting. They should be forwarded to the Corresponding Secretary, J. M. WHITHAM, at Fayetteville, Ark.

An assessment of $5 will be made on all members attending the meeting for the purpose of aiding to defray the cost of the annual entertainment and other incidental expenses.

All persons intending to be present at the meeting are requested to notify the Recording Secretary, at as an early a date as possible, so that suitable arrangements can be made. All correspondence in regard to the meeting should be addressed to the Recording Secretary.

F. W. GIBB, *Recording Secretary.*

**Master Car Builders' Association.**—The following questions have been submitted to a letter ballot of the members, with the results given after each question.

*Running Boards.* — The ends of the running boards of box-cars to be made to project over the ends of the cars, so that the *minimum* distance between the ends of those on adjoining cars will not be over 12-ins.; and that the running boards be made not less than 2 ft. wide, and made of three boards 7 × 1 in. The projecting ends to be supported on two brackets, at each end of the car, made of 3-8 × 1 1-4-in. iron, with a hardwood cleat 3 × 1 in. on upper ends, fastened with one 1-2-in. bolt and nut in each bracket. The lower end of each bracket to be fastened to the end of the car with two 1-2-in. bolts and nuts. *Adopted* by 329 "yes" to 84 "no."

*Ladders.*—Each end of every box and stock car to have a ladder attached to it next to the corner which is on the left-hand side when a person is facing the end of the car.

The sides of the ladder to be made of two pieces of hard wood 3 1-2 ins. wide by 1 3-4 in. thick, each piece to be fastened with four 1-2-in. bolts and nuts to the end of the car, the narrow sides of these pieces to be fastened against the car. The distance between the strips to be 15 ins.

Each ladder to have not less than five steps or rounds made of 5-8-in. round iron; each step to be fastened to the ladder sides with a 1-2-in. bolt in each end. The lower round to have a guard or projection, to prevent men from slipping when swinging around the end of the car to get on the step.

A hand-hold to be attached to the top of the car roof parallel with the ladder rounds 15 ins. from the end of the roof. The hand-hold to be made of 5-8-in. round iron, and to be not less than 17 ins. long from center to center of bolt holes, and to be fastened to the car with two 1-2-in. lag screws. *Defeated* by 261 "yes" to 171 "no", a two-thirds vote being required.

*Steps.* — Two good substantial steps to be made of wrought-iron of 1-2 × 1-4 ins. section to be fastened one to each side sill, next to the corner of the car to which the ladder is attached. The steps to be not less than 12 ins. long, measured horizontally between the sides, and the tread to be not less than 8 ins. below the bottom of the sill. The side of the step next to the corner of the car to be as near to the end of the car as is practicable. Each side of the step to be fastened to the sill with two 1-2-in. bolts and nuts.

A hand-hold to be attached to the side of the car above each step—to be placed horizontally 2 ft. above the bottom of the sills. The hand-hold to be made of 5-8-in. round iron, 2 ft. long in the clear between the ends; to have 2 1-2 ins. clear space between it and the sides of the car; to be fastened with one 1-2-in. lag screw in each end, screwed not less than 2 ins. into the framing. Another handle of the same size, and fastened in the same way, to be attached horizontally to the end of the car the same distance above the sills, and on the opposite side of the ladder. *Adopted* by 345 "yes" to 87 "no."

*Brake-shafts.*—The brake-shaft to be placed on what is the left-hand corner of the car when a person is standing on the track facing the end of the car. The ratchet wheel and brake-pawl to be fastened to a suitable casting attached to the roof. A railing or guard to be attached to the end and the roof of the car around the brake-shaft. The center of the brake-shaft to be 20-ins. from the middle of the car. The nuts on the ends of the brake-shafts to be secured by split spring cotters. *Adopted* by 312 "yes" to 102 "no."

*Axle for Cars of 60,000 lbs. Capacity.*—To adopt the form and dimensions shown in Fig. 3 (not given here) as a standard for axles for cars of 60,000 lbs. capacity. *Defeated* by 224 "yes" to 307 "no."

*Dimensions for Stem, Dead-Blocks and Carrier-Irons of M. C. B. Standard Automatic Coupler.*—To adopt the dimensions given in figures on Figs. 4, 5 and 6 (not given here) as standards for stem, dead-blocks and carrier-irons of M. C. B. standard automatic couplers. *Defeated* by 325 "yes" to 185 "no."

**National Brickmakers' Association.**—The third annual convention will be held at Memphis, Tenn., on Nov. 13, 14 and 15. We would remind our readers that at the convention of the American Society of Civil Engineers, at Milwaukee, Wis., in July, there was considerable interest shown in the "brick" question, and that Mr. D. V. PURINGTON, of Chicago, President of the Association, who contributed much interesting information in the course of the discussion, tendered an invitation to all who are directly or indirectly interested in the matter to attend the convention at Memphis. The following papers will be read and discussed: "Continuous Kilns", by FREDERICK HOFFMAN, Berlin, Germany; "Mistakes in Brickmaking", by H. H. MCCLURE, Rome, Ga.; "The Fluctuation in the Price of Brick and its Cause in the Far West", by JOHN MCCAIN, Denver, Col.; "Drying Brick", by E. W. HENDRICKS, Pullman, Ill.; "The Stiff Mud Process", by C. B. WILLIAMS, Willoughby, O.; "Brick Yard Construction", by A. R. BATLEY, Ironton, O.; "Profit and Loss in Brickmaking", by T. W. STANLAND, Summerville, S. C.; "Burning Brick with Crude Oil", by CHAS. S. PURINGTON, Chicago, Ill.; "The Evolution of the Brick Yard", by Prof. R. C. CARPENTER, Lansing, Mich.; "The Dry Process for Common Brick", by D. W. CAMPBELL, Kansas City, Mo.; "Efflorescence on Brick; its Cause and Cure", by Prof. J. F. ELSOM, New Albany, Ind.; "A Modern Brick Yard", by CHAS. E. ECKERT, Walkersville, Ont.; "Common versus Improved Kilns", by S. P. CRAFT, New Haven, Conn.; "Pavers" by J. J. W. BILLINGSLEY, Indianapolis, Ind. Also discussions on "Setting Brick" "Size of Brick", and "Repressing Brick." Other papers are expected to be presented, and there will be a "question box", an address by the President, D. V. PURINGTON, in addition to the general business of the convention. All who can, conveniently, are requested to take with them a burned brick for exhibition. For particulars address THEO. A. RANDALL, Corresponding Secretary, Indianapolis, Ind.

**Engineer's Society of Western Pennsylvania.**—At the meeting on Oct. 17, Col. T. P. ROBERTS read a paper on "The Railroad Situation in Pittsburg, with Reference to its Approaches," He referred to the situation of the city, located between hills, almost mountains, on the narrow margins of rivers, which margins are already utilized by factories, etc. The railroad tracks are blocked with through freight, but the conformation of the country is such that no first-class freight route can be made to avoid the Pittsburg gauntlet.

"A circular railway, around Pittsburg, with a radius of 8 miles, even with tremendous concessions in the way of elevations and grades, would involve 26 tunnels, varying in length from a few hundred feet to 1¾ miles, and

1¼ miles of river bridging averaging 200 ft. in height. Such a road would then fail to meet most of the railroads at grade. It is simply impossible to go around the built-up limits of Pittsburg, with an intercepting railroad unless we make such a road nearly a continuous tunnel."

Col. ROBERTS proposed to build up the river banks for railroad track uses. The volume of water, he thought, was not greater than before the settlement of this region, and since then the Monongahela had widened 300 ft. and the others proportionately. This, he thought, settled the flow question. The Ohio could be narrowed one-half without danger from floods, but that would interfere with navigation. He saw no reason why the width of the Monongahela should not be reduced, and thought six side tracks could be carried down the left bank of the Monongahela and as many down the right bank of the Allegheny. The only objection was the river line established by law, but that might be changed. The paper will be discussed at the next meeting of the Society, Nov. 20.

**American Institute of Architects.**—The annual convention was held at Buffalo, N. Y., last week. Reports were received from the several chapters, also from the officials and from the special committees. Papers were read and there was an exhibition of illustrations of current work in architectural design. R. M. HUNT is President of the Institute.

**Roadmasters' Association of America.**—The association has accepted the invitation of the citizens of Denver, Col., to hold its next annual convention in that city. The date is the second Tuesday in September, 1889, and the convention will last for 3 days. H. W. REED, of Waycross, Ga., is Secretary.

**Western Railway Club.**—At the meeting in the new quarters in the Phœnix Building, Chicago, the following were the subjects for discussion: "Circulation of Water in Locomotive Boilers"; "Material for Car Construction," and "Car Heating by Steam". W. D. CROSMAN is Secretary.

**American Street Railway Association.**—The annual convention was held at Washington, D. C., Oct. 17, 18, 19. Several interesting papers were read and discussed, and there was a good exhibition of appliances, equipment, track material, models of new inventions, etc. The following officers were elected: President, GEO. B. KERPER, Cincinnati, O.; 1st Vice-President, JESSE METCALF, Providence, R. I.; 2nd Vice-President, HENRY HURT, Washington, D. C.; 3rd Vice-President, W. H. MARTIN, Jr., San Francisco, Cal.; Secretary and Treasurer, WM. J. RICHARDSON, Brooklyn, N. Y.; Executive Committee, CHAS. B. HOLMES, Chicago; JOHN SCULLIN, St. Louis; J. H. JOHNSTON, Savannah, Ga.; HENRY A. SAGE, Easton, and E. J. LAWLESS, Kansas City, Mo. The next convention will be held at Minneapolis, Minn.

**Western New York State Association of Architects.**—The first annual meeting was held at Buffalo, N. Y., last week, President, JAMES G. CUTTER, of Rochester, presiding, and about 30 members of the total of 54 present. The report of the committee on competition recommended the adoption of the code of the Western Association of Architects. A long discussion followed, many of the members deeming the method of procedure outlined in the code too elaborate for common use in ordinary competitions. The motion was finally put and lost, and the report referred back to the committee for further consideration. This committee rendered a special report recommending that hereafter members of the association enter no competition unless paid for their work. This was adopted.

The following officers were elected: President, J. G. CUTTER, of Rochester; First Vice President, FRED. H. GOUGE, of Utica; Second Vice President, J. H. KIRBY, of Syracuse; Secretary, W. W. CARLIN, of Buffalo; Treasurer, OTTO BLOCK, Rochester; Members of Executive Committee, F. A. CURTIS, of Fredonia and T. G. LACEY, of Binghamton.

The next meeting will be held at Rochester, N. Y., the first Tuesday in February, 1889.

**Michigan Engineering Society.**—The annual meeting of the Board of Directors was held at Lansing, Mich., Oct. 10. The following officers were elected for the year beginning Oct. 10: President, GEORGE E. STEELE, of Traverse City; Vice President, JOSEPH RIPLEY, of Detroit; Secretary, F. HODGMAN, of Climax; Treasurer, GEO. S. PIERSON, of Kalamazoo; Directors, Prof. M. E. COOLEY, of Ann Arbor, and WM. APPLETON, of Lansing. It was decided to hold the next annual convention at Lansing, beginning Tuesday, Jan. 22, 1889.

Arrangements were made for the preparation of papers on "Explosives in Engineering"; "The Application of Photography to Surveying and Engineering"; "The Nicaragua Canal Surveys"; "Smelting Works and Machinery"; "Kalamazoo Water Supply"; "Tests of Michigan Woods"; "Building Stones of Michigan"; "House Drainage"; "Water-Works Machinery"; "Block Pavement"; "Logging Railways and Equipment"; "Railway Location in Northern Michigan"; "Railroad Construction and Location"; "Drainage in the Huron Peninsula"; "Village Plots" (including an exhibit from the Auditor General's Office); "Railway Maintenance and Track Accounts"; "Land Surveys in the Forests of Michigan"; "Practical Mining"; "Fishways"; "Paints for Railroads and Bridges", etc. Arrangements were made for a stereopticon exhibition of views of subjects of interest to engineers and surveyors.

F. HODGMAN, *Secretary.*

[From our own correspondent.]

**American Society of Mechanical Engineers; 18th Meeting, held at Scranton, Pa., Oct. 15 to 19, 1888.**—The start of this Society from New York afforded an example of the futility of putting too much trust in human nature. "Put not your trust in Princes", is a biblical maxim, but our Secretary would amend this by substituting the word "engineers." Attention is called to this rather as a means of impressing certain careless men with the thought that they should, in every instance, face their responsibilities. Those gentlemen who sent the Secretary their names as desirous of going to Scranton in the special cars and failed to come, will be very much surprised to learn that each failure cost the Society at large over $20. One can imagine how these members would have stormed, had they arrived and not found sufficient accommodation in the train. Yet 90 names were entered, requiring three cars, and but 60 appeared. The other car, of course, had to be paid for. The Committee of the Civil Engineers on the Denver trip were wiser. The price fixed was $60 per head, and it was stated that berths would be given out as applied for, and further that $20 must accompany each application and that no rebate would be made if any one failed to go. The writer calls attention to this subject in view of the proposed trip to Europe next spring by the three Societies, and it is quite evident the Denver rule or something like it must prevail.

As stated, the engine which hauled the party was the celebrated Strong Locomotive 444, and the trip was made with entire success, through the beautiful region of the Lehigh Valley. The trees with their variegated coloring added much to the beauty of the scene. The party arrived in Scranton a little ahead of the schedule time. The speed of the engine was favorably commented on, and the ease with which it handled the heavy train over the steep grades and around sharp curves. The rate at times approached 70 miles per hour. The writer having ridden in this engine and taken the time by the mile post, has no hesitation in saying she has not her equal in the world. We were told the company is now building a much heavier engine for the A. T. & S. F. R. R., which is to haul 14 Pullman cars, 60 miles per hour.

That the engine will fulfil this demand, few who know Mr. STRONG will doubt. Like most enthusiasts he has had unbounded faith in his own work, and sometimes has perhaps made promises not immediately carried out; but eventually he has done what he set out to do, and it is believed, that the future will show he has not made too great claims for his invention.

The headquarters at Scranton were at the Westminister hotel, conveniently located opposite the Young Men's Christian Association Rooms, where the meetings were held. What the effect of this location will be on the members at large remains to be seen. At all events, matters and things seemed to go on as usual, for Scranton is not a prohibition town, and gets all its "supplies" from GIBSON of Philadelphia.

It was a great source of regret to all that the President of the Society, Mr. HORACE SEE, of Cramp & Sons, was unable to be present on account of a severe illness. His remarks on such occasions have always been extremely happy and interesting.

Col. J. A. RICE of Scranton made a fitting address of welcome alluding to Scranton as the capitol of the anthracite regions, and he might have added that Philadelphia was the capital. Col. RICE also stated the adaptability of the abandoned mine galleries for the growth of mushrooms, but he was not understood as being in any way personal, for he called the Society men of genius, and said they represented the flower and fruitage of mechanics, and suggested that the way to deal with the emigration problem was to educate the emigrant. It is believed that Col. RICE's view is one that has already engaged the attention of statesmen and of employers in the United States. What we are gradually obtaining, and what gives this nation such a tremendous advantage over foreign nations is, that our mechanics are educated to a far higher degree than those abroad. Enterprises like the "Brooks Locomotive School" and the various manual training schools springing up in all directions are not only educators, but they are to become factors in our political field and in our national policy as well. Ignorance is undoubtedly at the root of labor strikes. The rank and file of the Knights of Labor if educated would not tolerate the arrogant pretensions of their leaders for an instant and would utterly refuse to be led blindfolded into positions which never benefit themselves, simply that some petty tyrant may show his "brief authority." This state of education is coming and with rapid advances and its advent means the pre-eminence of skilled and *intelligent* American labor over any other labor in the world.

The response to Col. RICE'S remarks was made in suitable terms by Mr. C. J. H. WOODBURY, Vice President, in which he paid a fitting tribute to two pioneers of Scranton, MOSES TAYLOR and Mr. WM. SCRANTON:

The regular session then commenced. The first paper being "The Distribution of the Internal Friction of Steam Engines" by Prof. R. H. THURSTON. The plan for testing was to first ascertain the friction of the machine in the usual manner and then to dismantle it, part by part, and drive the connected parts by a pulley and belt from the main line of shafting overhead through a transmitting dynamometer carefully standardized, and thus measurements of the resistance of part after part were obtained. The results showed the greatest loss to be at the main bearings and it amounted to 1-3 to 1-2 of all the friction resistance. The next greatest loss was the friction of the piston rods and the rubbing of the rings and the friction of the rod packing, and the third greatest loss was due to the friction of the valve. The natural inference was then drawn that this showed that the best way to increase the efficiency of an engine was to so design it as to make these losses a minimum. The second paper was also by Prof. THURSTON and entitled: "Variable Load, Lateral Friction and Engine Speed and Work". This gave substantially the results of a series of trials made with various engines under different speeds and loads. Prof. J. E. DENTON'S paper on "The Friction of Piston Packing Rings in Steam Cylinders" followed In fact the whole discussion thus far had been on the subject of friction, and after adjournment the members proceeded, that is *some* of them did, to "lubricate", and then to seek a much needed rest.

TO BE CONTINUED.

## CONSTRUCTION NEWS.

### RAILROADS.

### East of Chicago.

#### Existing Roads.

***Sandy River.***—The directors of this Maine road, of 24 ins. gauge, have voted to purchase 100 tons of 35-lb. steel rails and 6 box cars.

***Lake Erie, Essex & Detroit River.***—Track has been laid on this road in western Ontario to within two miles of Kingsville, and trains will be run to that village next week.

***Pennsylvania.***—It is reported that the 5 mile branch of the West Jersey road recently built from Sea Isle City to Seven Mile Beach, is to be extended to Cape May, and surveys are now in progress. The purpose of the extension is to furnish a new route to Cape May, running all the way along the beach. Proposals are to be received till Oct. 29 by Chief Engineer WM. H. BROWN for the masonry and grading for two additional tracks for 3 1-2 miles on the Pittsburg division; and for a change of line for three tracks 1 1-2 miles in length on the Philadelphia division.

***Pittsburg, Shenango & Lake Erie.***—It is announced that work is to be resumed on this road on Nov. 1, $2,500,000 of bonds having been placed with a Philadelphia syndicate. The road is completed to Amass, Pa., and is to be extended from that point north to Conneaut, O., a port on Lake Erie.

***Great Northern.***—Grading is nearly finished on the 10 mile extension from New Glasgow to Ste. Julienne, P.Q., for which JOHN MCENCROE, of Schenectady, N. Y., has the contract. Surveys are being made for a proposed extension toward Quebec *via* St. Gabriel de Brandin. C.S. BAKER of Montreal is Chief Engineer.

***Toledo, Columbus & Southern.***—This Ohio road was sold at foreclosure sale at Toledo, O., on Oct. 16 to STEVENSON BURKE, of Cleveland, representing the bondholders.

***Toledo, St. Louis & Kansas City.***—Citizens of Marion, Ind., are trying to secure the removal of the shops now located at Delphos, O., to Marion.

***Central Railroad of New Jersey.***—It is stated that this company has just closed contracts for 30 consolidation locomotives, 2,000 coal cars, and 500 box cars, 30 passenger coaches, and 5,000,000 lbs. iron beams for use on the New Jersey City depot.

***Baltimore & Ohio.***—The semi-annual dividend on the common stock of this company was passed for the third time at the recent directors meeting. For the year ending Sept. 30, 1888, the following statement was submitted

| | 1887. | 1888. | |
|---|---|---|---|
| Earnings..... | $20,650,036 | $20,361,678 | $297,358 decrease |
| Expenses..... | 14,120,133 | 14,311,727 | 191,595 increase |
| Net..... | $6,538,904 | $6,049,951 | $488,953 decrease |

President SPENCER stated that the decrease in gross earnings was due to the sale of the express and sleeping car systems, the receipts from which were included in the operations of 1887. The increase in operating expenses was due principally to an expenditure of $475,000 on the improvement of track, bridges and rolling stock.—A trip for inspection of the new terminals at New York City was made by the directors and principal officers on Oct. 20.

The work on the Arthur Kill bridge and its approaches is making good progress and will be completed by spring.

*Albert.*—This New Brunswick Railway is to be sold at St. John's, N. B., on Nov. 15, at foreclosure sale. At a meeting in London of the first mortgage bondholders on Oct. 9, it was voted to purchase the line. Dr. ROBERT J. GRIFFITH is chairman of the purchasing committee.

*Philadelphia & Reading.*—The Board of Trade committee on the Terminal project are examining the plans prepared by the company's engineer, JOHN A. WILSON. The estimated cost of the work, executed according to the company's original plan is four million dollars. To carry out the work as demanded by the City Councils, Mr. WILSON estimates would cost twelve million dollars.

*Canadian Pacific.*—Meetings of the shareholders of this company and of the Ontario & Quebec company will be held at Montreal on Nov. 19, to ratify the lease of the extension from London, Ont., to the Detroit river at Windsor, on which grading has just started.

*South Pennsylvania.*—A meeting of stockholders has been called to discuss the reorganization of this company and will be held at Pittsburg on Friday, Oct. 26. The stockholders who have assented to Andrew Carnegie's plan of reorganization are Daniel Hostetter, Henry Phipps, Jr., D. O. Mills, W. C. Whitney, H. F. Dimock, O. H. Paine, Franklin B. Gowen, C. and H. Borie, E. C. Knight, F. D. Lewis, J. D. Rockefeller, W. Rockefeller, E. E. Wicks, J. B. Lippincott, Trustee J. B. Colgate, A. J. Stewart, and J. A. Kane, by attorney. The principal ones who have not assented to the plan are Ralph Bagaley, B. F. Jones, A. C. Frick, M. Watson, John Chalfont, H. S. McKee, and E. M. Ferguson.

### New Projects and Surveys.

*George's Valley.*—The town of Union, Me., has voted $29,000 in aid of this road, which is projected from Augusta to Warren, on the Knox & Lincoln Railroad. The well-known railway contractors, Mitchell & Spofford, have offered to build the road for $41,000, equip it and have it in running order next season, and this action of the town is the first step to meet the offer. Measures will be immediately taken to raise the remaining $12,000. I. C. THURSTON, F. E. LITTLEHALE and E. L. THOMPSON were appointed a committee to contract for building the road.

*Vincennes & New Albany.*—A special meeting of the stockholders of this company will be held at Vincennes, Ind., on Nov. 13, for the purpose of taking action toward raising funds for the construction of the road. The line was located and a good part of the right of way was secured last year. EDWARD WATSON of Vincennes is President.

*Ottawa, Waddington & New York.*—The following directors were elected at the recent meeting. W. J. ANDERSON, JAS. REDINGTON, ALEX. FARLINGER, J. J. MCCRACKEN, Mrs. GRACE KEEFER, CHAS. O'DELL. Ottawa will be asked for a bonus of $50,000 in aid of the road.

*Seymour & Bedford.*—This company has been organized at Seymour, Ind., to build a railway from Seymour to Bedford, about 35 miles. LOUIS SCHENCK of Seymour is interested.

*Evansville & Richmond.*—The city of Columbus, Ind., has voted against the proposed 2 per cent. tax in aid of this enterprise.

*Oneida, Oneonta & New York.*—Subscriptions are being solicited to this enterprise at Oneonta, N. Y.

*Gloucester City & Atco.*—The city council of Gloucester, N. J., has passed the ordinance granting right of way to this company, which was formed in the interest of the Central Railroad of New Jersey and the United States Express Company, to build a railroad from Gloucester to Atco, on the New Jersey Southern.

## SOUTHERN

### Existing Roads.

*East & West Alabama.*—CHAS. P. BALL of Montgomery, Ala., has been appointed Receiver of this company to succeed Captain JOHN POSTELL.

*Gulf & Ship Island.*—Construction is at a standstill on this Mississippi road and it is reported that many employés have received no pay for four months past.

*Nashville & Knoxville.*—On this Tennessee road the grading is completed from Lebanon east to Cookeville, 66 miles, with the exception of 11 miles from Carthage east. Trains are running regularly from Lebanon to Gordonsville, 30 miles. Track is expected to be laid from Gordonsville to near Carthage and from the Hickman Y to the Caney Fork river, unless delayed by the bridge erecting gangs, by Jan. 15, 1889. The total cost of the road thus far has exceeded $800,000. The bridge over the Caney Fork river and the completion of the line to Cookeville will cost $300,000 more, and $500,000 will be required to extend the line to the Fentress county coal fields.

*Ohio Valley.*—President P. G. KELSEY states that the extension from Princeton, Ky., south, will be undertaken as soon as the Evansville extension is completed.

*Talladega & Coosa Valley.*—It is stated that this Alabama company will begin work this fall on an extension from Talladega east to a junction with the East Alabama railroad. The extension will be built standard gauge, and the existing line from Talladega to Pell City will be widened.

*Anniston & Cincinnati.*—The first through train over this Alabama road from Anniston to Attala was run on Oct. 17.

*Chattanooga & Lookout Mountain.*—This company is making surveys for the extension of its line.

*Alabama Midland.*—At the meeting held last week at Bainbridge, Ga., the contracts with the Plant Investment Co., the Savannah, Florida & Western Ry. Co., the Southern Express Co. and the Alabama Improvement & Terminal Co., were ratified. Pres. O. C. WILEY of Troy, Ala., presided. Grading is to begin at once at Bainbridge, Ga., and the whole line is to be completed by Oct. 1, 1889.

*Louisville & Nashville.*—The report that the company will not resume work on its shops which were under way at Decatur, Ala., at the time of the yellow fever outbreak, but will build at Birmingham instead, is probably unfounded.

*Memphis & Charleston.*—Work is to begin at once on the company's shops in Sheffield, Ala., the cost of which is estimated at $300,000.

### New Projects and Surveys.

*Hardinsburg & Western.*—A survey is in progress for this Kentucky road from Hardinsburg to a connection with the Louisville, St. Louis & Texas. J. C. FAWCETT of the latter company is President.

*Anniston Terminal.*—Incorporated to build a belt railroad at Anniston, Ala., by A. L. TYLER, S. E. NOBLE and others of Anniston.

*Cairo & Tennessee River.*—President B. A. NEAL of Mayfield has secured rights of way and subscriptions in aid of this enterprise from all the counties from Cairo to Hopkinsville, Ky., except Ballard, Graves and Christian. The vote in the latter county will be taken on Nov. 1.

*Cordele, Waynesville & South Brunswick.*—This company is to be chartered this winter to build a railroad from Cordele to Waynesville, Ga. MALLORY P. KING, HENRY R. SYMONS and W. F. PENNIMAN of Brunswick are the incorporators.

*Memphis, Tuscaloosa & Atlanta.*—Chief Engineer BELTON MICKLE will complete the survey for this Mississippi road this month.

## THE NORTHWEST.

### Existing Roads.

*Northern Pacific.*—The various rumors of a consolidation between this company and the Wisconsin Central seem to have little foundation in fact, and even the report that through trains are to be run to Chicago over the Wisconsin Central is denied. The company has ordered some vestibuled trains for its passenger equipment.——Reports of the company's earnings continue to show large increases. For the second week in October the earnings were $503,709, an increase of $135,657 over the corresponding week of last year. At this rate the gross earnings for the month will considerably exceed $2,000,000.

*Northern Pacific & Manitoba.*—The Provincial Government of Manitoba, which is building the line which the company is to operate from Winnipeg to Portage la Prairie, is having serious trouble in its attempt to lay a crossing over the Canadian Pacific track at a point about four miles from Winnipeg. The Canadian Pacific company has placed a locomotive on the crossing and has a force of 400 men armed with clubs and revolvers ready to resist any attempt of the opposing party to lay the crossing by force. The militia are under arms and will prevent a collision if possible.——The contract has been closed by the Government with the company for the construction of a branch to the Souris district, and work is to begin at once.——The freight rates from Winnipeg to the Twin Cities just published, show a reduction of about 13 per cent. from those in force over the Manitoba & Canadian Pacific.

*Winona & Southwestern.*—The first locomotive for this company has been delivered, and work on the tracklaying is to begin at once.

*Manitoba & Northwestern.*—Track has been laid on the extension of this Manitoba road to Saltcoats, N. W. T., 306 miles northwest of Portage la Prairie.

*St. Louis, Alton & Terre Haute.*—The general offices of this company have been moved to Pinckneyville, Ill. A new building for their accommodation is soon to be erected.

*St. Paul, Minneapolis & Manitoba.*—The last spike on the Duluth, Wilmar & Sioux Falls railroad, from Wilmar, Minn., to Sioux Falls, Dak., 146.9 miles, was driven at Sioux Falls on this week. This completes a through air line from Sioux Falls, Dak., to Duluth, Minn., all under control of the Manitoba system. It is the largest extension built by the Manitoba this season, but most of the grading on it was done last year.——It is rumored that a force of surveyors is running a line north from a point on the Eastern Minnesota, 25 miles from West Superior.

*Great Northwest Central.*—The first 50 miles of this road from Brandon, Manitoba, northwest, will be completed by March 1, 1889.

*Aberdeen, Bismarck & Northwestern.*—The house bill granting this company right of way across a portion of the Sioux reservation in Dakota has been passed.

*Duluth & Winnipeg.*—The contract of Foley Bros. is for 65 miles of road instead of 10 miles, as stated last week. A large force is to be put on the work at once. A corps of 7 surveyors under CHAS. HARLOWE of St. Paul started from Cloquet on Oct. 17, and are working along the west bank of the Cloquet river. The company is anxious to finish 10 miles of road this fall and secure the land grant made to the company.

### New Projects and Surveys.

*Deadwood Central.*

DEADWOOD, D. T., Oct. 19, 1888.

EDITOR ENGINEERING NEWS:

The survey has been finished and maps filed at Washington, for about 8 miles of the Deadwood Central Railroad, from Deadwood to Ruby Basin, in the gold mining district, up Whitewood and Fantail gulches. The total projected length of the road is about 200 miles, and 50 miles, are under survey. The line runs through a mountainous country. The work is mostly in rock and loose rock. Maximum grades are 65 ft. per mile; curvature, 30°. The principal traffic will be hauling ore, and coal supplies to the mines; but the line will carry passenger traffic as well. Right of way is nearly secured for the first 8 miles and contracts will be let Nov. 1, for the first 3½ miles. No local aid is asked and the capital for construction has been subscribed by the projectors and paid *in cash* at the start. We expect to begin tracklaying in 30 days and have a portion of the line open for traffic by Feb. 1, 1889. A. D. WILSON is Chief Engineer and A. W. COE is Secretary.

JAS. K. MILLER, *President.*

*Lake Superior & Southwestern.*—

AUSTIN, MINN., Oct. 17, 1888.

EDITOR ENGINEERING NEWS: Our project is still alive and we are more confident than ever that we shall build along our proposed route. I enclose map which gives correct line of our road. We are corresponding with the Soo & S. W. Ry. to get east by that route, also with the Duluth & Southern for lake facilities. We have our surveys and profiles complete from Rochester, Minn., *via.* Austin to Northwood, Iowa. We have not commenced building, as we propose to be sure of our connections first. We have some right of way contracted for.

C. D. BELDEN, *Secretary.*

*Columbia & Northern.*—

COLUMBIA, Dak., O t. 15, 1888.

EDITOR ENGINEERING NEWS: The Columbia & Northern Railroad was chartered July 15, 1888, and a preliminary survey was made in the same month from Columbia *via.* Newark and Foreman to Milnor, Dak., about 60 miles. The proposed route is very level and the line would require little grade or filling. Most of the right of way will be given gratis, and local aid has been secured sufficient to grade the road. Negotiations are now pending for the capital to build the road, and there will be an endeavor by the Northern Pacific to secure its control. We expect now that the road will be built next year. JOHN D. LAVIN is President of the company and A. H. HILDEBRAND is the engineer in charge of preliminary survey.

G. M. LYON, *Secretary.*

*East Chicago, Kensington & Lemont.*—This company has been chartered in Illinois to build a railroad from the Indiana State line, between the Michigan Central Railroad and the Grand Calumet river, to a point on the Kankakee river between Kankakee and Grundy counties. W. M. WILSON, W. J. STAPLETON, E. P. PRENTICE, E. A. BRYAN, and FRANK C. SMITH are the incorporators.

*Sioux Falls, De Smet & Northern.*—

DE SMET, Dak., Oct. 16, 1888.

EDITOR ENGINEERING NEWS:

This company was chartered June 8, 1888, and has completed surveys the past summer from Sioux Falls, Dak., *via* Dell Rapids, De Smet, Clark, Groton, and Columbia to Oakes, Dak., a distance of 200 miles. The route is through a prairie country, the general grade is about 30 ft. per mile. The line is projected to benefit the towns above named along its route, and the enterprise receives their active coöperation. No material progress has been made in obtaining right of way, and no other capital for construction has been secured. We expect to let contracts early in 1889. M. S. PARKER, of Winona, Minn., is our Chief Engineer.

J. H. CARROLL, *President.*

*Perry & Maysville.*—This company has been chartered in Illinois to build a railroad between the points named, in Pike county, by A. H. INMAN, ALEX. DORSEY, JAS. H. HARRISON, and others, of Perry.

*Ontario, Manitoba & Western.*—Z. MALHOIT, of Port Arthur, Ont., has made surveys from Port Arthur Ont., to Hunter's Island, through the Rainy River county. The route is regarded as quite feasible for the construction of a railway and the value of the timber country opened up is such that the enterprise promises good profits.

## THE SOUTHWEST.

### Existing Roads

*Cleveland, St. Louis & Kansas City.*—Grading began on Oct. 20 on this line at a point opposite Alton, Ill. No work has been done as yet toward the construction of the proposed bridge.

*San Antonio & Aransas Pass.*—Grading has been completed on the extension to Houston, Tex., 56 miles from the present terminus at the Brazos river. It is expected that the rails will be laid at once.

*Missouri Pacific.*—The contract for the branch from Benton, Ark., to Hot Springs has been awarded to McCarthy & Kerrigan of Little Rock.

*St. Louis & San Francisco.*—The Board of Trade of Little Rock, Ark., have received the following letter:

ST. LOUIS, October 18, 1888.—Hon. Sam O. Smith, Vice President Board of Trade, Little Rock, Ark.: DEAR SIR—Yours of the 13th inst. received and considered. I assure you that our company fully appreciate the importance and magnitude of the business of your city, and for some considerable time past has had under consideration the propriety and feasibility from a financial point of view of extending its line to or through your

city, which we regard as the metropolis of your State. Should our company in the future conclude to extend one of its lines to Little Rock, I will give you timely notice, and shall be pleased to confer with you in relation to the matter. Kindly give me an estimate of the aid which you think your people will be willing to grant to our company on condition that it extend one of its lines to your city. Yours truly, JOHN O'DAY, *Vice President.*

In reply the Board expressed their belief that the city would raise a subsidy of $50,000 and secure the company terminal facilities and right of way through the county.

***Austin & Northwestern.***—This Texas company is to issue $125,000 in bonds for the purpose of completing the extension to Marble Falls.

***Texas & Pacific.***—It is probable that this road will be taken out of the Receiver's hands in a few weeks.

***Atchison, Topeka & Santa Fé.***—An extension has been completed from Concordia, Kan., northwest to Superior, Neb., about 40 miles, and has been opened for business. It is stated that the company is negotiating for the sale to the Missouri Pacific of the Leavenworth, Northern & Southern railroad, built last year from Atchison south *via* Leavenworth to connect with the company's main line. The company is reducing expenses wherever possible. The stone quarry at Independence, Mo., has been closed and of the 34 trains which have been employed in ballasting 30 have been withdrawn; the engines being needed for freight service. Last week the company delivered at Kansas City, 1,056 car-loads of live stock, against 600 car-loads in the corresponding week of 1887.

President STRONG has issued his annual statement to the stockholders. This shows that the new construction for the year has amounted to 2,776.3 miles, thus making the total system 6,531 miles. The bonded indebtedness on the above mileage, exclusive of the income bonds of the California Southern and the Chicago, Kansas & Western, averages less than $20,850 per mile, and the capital stock is less than $11,500 per mile. The property is in excellent condition, well equipped with rolling stock, and the company owns valuable coal mines in Kansas Colorado and New Mexico.

Controller John P. WHITEHEAD'S statement shows that the present net floating indebtedness does not exceed $5,000,000 (exclusive of $1,440,000 for 3,000 coal cars). It has been decided to postpone the funding of this indebtedness until a more prosperous time, when it can be done without undue sacrifice. Meanwhile, to protect the company a guarantee fund of $7,000,000 has been fully subscribed, the money on which will be called to any extent which may be necessary.

***Chicago, Rock Island & Pacific.***—An item is going the rounds of the daily press to the effect that this company intends to build this winter an extension from Liberal, Kan., to El Paso, N. M. The distance is about 500 miles air line and the route is through a country not famous for fertility or for the facilities it offers for railway construction. El Paso is a very popular terminus for Kansas railway projects but it is not likely to be the terminus of the Rock Island system for a good while to come.

#### New Projects and Surveys

***Paris, Choctaw & Little Rock.***—

PARIS, Tex., Oct., 18, 1888.

EDITOR ENGINEERING NEWS.—The Paris, Choctaw & Little Rock Ry. Co. was chartered in May, 1888, and proposes to build a rail way from Paris, Tex., northeast through the Indian Territory to Little Rock, Ark. Surveys began in July and the first 30 miles, to the Red river has been surveyed and is now being located. The line runs *via* Shockey Prairie, Woodland, Kanawha and Towson. There are no grades exceeding 30 ft. per mile. The largest bridge will be across the Red river. The country is wooded and rolling. The principal sources of traffic will be the cotton of Texas and the minerals of Arkansas, lead, iron, silver, gold, antimony, etc. The line will be the shortest route from Texas to Memphis, Tenn. Right of way has not been secured but will be donated principally. Local aid to the amount of over $30,000 has been given by citizens of Paris, Tex., and other capital will be secured.

S. J. WRIGHT, *President.*

***Dallas & New Orleans.***

DALLAS, Tex., Oct. 18, 1888.

EDITOR ENGINEERING NEWS:—The Dallas & New Orleans Railway was chartered in February, 1887, and is to run from Fort Worth, Tex., *via* Dallas and Kaufman in an air line toward New Orleans, a distance of 450 miles. The surveys are nearly completed and right of way is nearly all obtained. The earthwork on the line will be very light and there will be but little bridging. The enterprise has received various subsidies in the way of local aid, and bonds have been floated in London to furnish the capital for its construction. Contracts will probably be let in November, 1888; and we hope to push the work so that we can begin tracklaying before the close of the year and have a portion of the line open for traffic within six months. The office of Chief Engineer in our company is now vacant.

JAMES B. SIMPSON, *President.*

***Louisiana, Arkansas & Northern Central.***—The Board of Trade of Little Rock, Ark., has received the following communication:

LOUISIANA, ARKANSAS, AND NORTHERN CENTRAL RAILROAD, CONSTRUCTION DEPARTMENT, 185 DEARBORN STREET, CHICAGO, October 17.—Sam. O. Smith, Esq., Vice President Little Rock Board of Trade, Little Rock, Ark.: DEAR SIR—I wish to inform your board that a preliminary survey is now being made for a main line of road from Oskaloosa, Ia., following the ninety-second meridian of longitude, or nearly so, south to the Gulf of Mexico. This line will pass the city of Little Rock. It will also cross the San Francisco road southwest of Rolla. We are getting our matters into shape as fast as possible for the rapid construction of this line. It is the intention of the management, whose headquarters are in New York City, to notify all parties interested as soon as possible in a formal manner. I have assumed this responsibility and have thus notified you from my office in order to furnish you with this knowledge a little sooner than you probably would have obtained it had I not been informed through the newspapers. This I hope will not be considered to interfere in any way, however, with any plans your board have already matured. I would like, however, to inform you that we especially solicit your aid in every direction to assist us in our efforts. This road will open up an ocean port for export business, and already parties who are interested in the construction of this road are in the foreign markets making contracts for several products of your State. As I have herein stated, I do not wish this letter to be considered as a formal notice as you will receive such notice in regular manner from the department that such intimation should regularly come from. Yours respectfully, J. H. MARTIN. *Supt. Construction.*

***Cherokee Central.***—GEO. D. COOK of Chicago is one of the parties interested in this new Kansas company, mentioned last week.

***Lake Providence & Western.***—A 5 mill tax for ten years has been voted to aid this company at Lake Providence, La.

## ROCKY MOUNTAIN & PACIFIC.

#### Existing Roads.

***Colorado Midland.***—The extension to Newcastle Col., 12 miles in length, was opened for traffic on Oct. 20.

***Denver & Rio Grande.***—A large force is at work widening the gauge of the main line from Denver to Pueblo, and it is intended to complete it by NOV. 1. On the Leadville line, the road has been made standard gauge as far as Canon City.—The switchmen in the company's yards at Pueblo, struck on Oct. 22.

***San Francisco & Northern Pacific.***—According to an interview with President DONAHUE in the San Francisco *Call*, it is intended to push the line north through Mendocino and Humbolt counties at an early date. The Sonoma Valley road will be altered to standard gauge and extended to Los Guilliecos. Work will probably begin next spring. The Cloverdale & Ukiah extension is graded ready for the rails, which will be laid as soon as the fastenings, which were sent by ship from Philadelphia, come to hand.

***Visalia & Tulare.***—This dummy road, 10 miles in length, at Visalia, Cal., has just been completed.

***Southern Pacific.***—The offices of the Oregon & California Railroad at Portland, Ore., are to be removed to San Francisco as soon as the fourth story of the new office building is finished. Plans are in preparation for the bridge across the Carquinez Straits. It has not been decided whether the bridge will be located at Dumbarton Point or at North Vallejo. The projected line from Oakland to Merced will be built and will be extended to connect with the Fresno branch at Sanger. Track will be laid soon on the line graded from Newman south to Hanford. These plans are all subsidiary in importance, however, to the completion of the coast line *via* Templeton and Santa Barbara, and the working forces are for the present to be concentrated on this.

***Mexican International.***—It is rumored that the Mexican Central is negotiating for the purchase of this road, built last year by C. P. HUNTINGTON and others interested in the Southern Pacific Co. The line runs from Eagle Pass, Tex., southwest to a junction with the Mexican Central at Torreon, Mex., 617 miles. The ownership of this line would greatly assist the Mexican Central in its competition with the Mexican National; its present route *via* El Paso being much longer than its competitor's for through traffic between the United States and Mexico.

***Puget Sound Shore.***—P. H. TYNDALL has been elected President of this Washington Territory company to succeed SIDNEY DILLON. The change brings the line into harmony with the Northern Pacific interests.

#### New Projects and Surveys.

***Astoria & South Coast.***

ASTORIA, CLATSOP CO., Oregon, Oct. 12, 1888.

EDITOR ENGINEERING NEWS:

The Astoria & South Coast Railway Company was incorporated in August, 1888, and is to run from Astoria *via* Skipanon and Seaside to Tillamook Bay. The division from Seaside to Tillamook Bay, 20 miles, is under survey, and the first location is nearly completed. The first 20 miles is level, the balance is mountainous. There will be a mile and a half of trestle across Young's bay, with a draw span. The road will open up a magnificent seaside resort, and will carry a large passenger business in the season. A heavy freight traffic in lumber, coal, etc. is also expected. Right of way is now being obtained and stock subscriptions are secured. No contracts are let yet, but we hope to begin tracklaying by April 1, 1889. JOHN A. DEVLIN is President of the company.

HENRY P. THIELSEN, *Chief Eng. and Supt.*

***San Diego, Old Town & Pacific Beach.***—

908 Fifth St., SAN DIEGO, Oct. 10, 1888.

EDITOR ENGINEERING NEWS:

This railway was chartered April 19, 1888, and is to run from corner of D and Arctic Streets in San Diego, north through Old Town to Pacific Beach, a distance of 11 miles. Surveys are finished and right of way is nearly all obtained. The principal business will be suburban passenger traffic; but it will also carry freight. There will be one bridge across the San Diego river. A. G. GASSEN is President and Chief Engineer. A. A. BORCHERS.

***Summit County.***—This company has been chartered in Utah with a capital stock of $1,000,000 to build a railway from Coalville and run up Chain creek to the southwest corner of Wyoming Territory, a distance of 25 miles.

***Wyoming & Eastern.***—According to the reports from Wyoming and Utah, this company, the Salt Lake Valley & Eastern, and the Nebraska & Western, have filed mortgages to the Manhattan Trust Company of New York City to secure bonds at the rate of $20,000 per mile on a railway to extend from Sioux City, Ia., to Salt Lake City, a distance of between 900 and 1000 miles. There is no doubt that such a project has been under way for some months; but there is no prospect that its promoters can induce investors to put up the money necessary to build such a road for a good while to come.

***Stockton, Tulare & Southern.***—Surveys are reported finished for this California road and if the bonds which have been issued can be floated, the managers intend to begin construction at once; the line is to run from Stockton *via* Oakdale to Fresno, about 150 miles. HENRY L. DAVIS of San Francisco is President.

***Kootenai & Columbia.***—It is stated that this company which was chartered recently by the legislature of British Columbia, has disposed of its charter to the Canadian Pacific, who will build the proposed line.

### Contracting.

**The Pacific Coast Well Boring Co.** has been incorporated at Los Angeles, Cal., by F. M. CLARK, S. CLARK, THOS. KILPATRICK, W. F. KILPATRICK and C. H. WARD. Capital stock, $30,000.

**Road Grading.**—At Portsmouth, O., the Commissioners have awarded contracts for grading on the Mt. Joy and Galena pike to Wm. Quirk, 65 rods at $1.83 per rod; Geo. White, 120 rods at $2.86 per rod.

**Pumping Engines.**—*Hyde Park, Ill.*—The Village Board has awarded the contract for the additional pumping engines, with a daily capacity of 12,000,000 gails., for the water-works, to H. R. Worthington, of New York, at $59,000.

**Stone and Gravel.**—At Shreveport, La., the Improvement Committee has awarded the contract for 1,000 cu. yds. of rock to John Monkhouse, at $2.75 per cu. yd.; the contract for 100 car loads of gravel was awarded to Johnston & Co. at $2 per cu. yd.

**Depot.**—Work has been commenced on the New York Central depot at Lockport, N. Y. The depot will cost between $50,000 and $75,000, and it is said that it will be architecturally one of the handsomest between Buffalo and New York. It will be of white sandstone trimmed with red, and contain all the modern improvements. The work will be pushed forward rapidly.

**Paving.**—At Oakland, Cal., the contract for paving on Franklin St. has been awarded to the Pacific Paving Co. as follows: 86,343 sq. ft. of macadamizing and bitumen, 14 cts., $13,088.02; 3,478 lin. ft. of curbing, 60 cts., $2,086.30; 800 lin. ft. of culverts, $2.75, $2,200; 8,400 sq. ft. of gutter, 10 cts., $840; total, $17,214.82. The bid of the Essex Paving Co. was as follows: macadamizing and bitumen, 15⅞ cts., $13,706.95; curbing, 65 cts., $2,260.70; culverts, $2.70, $2,160.70; gutter, 9 cts., $756; total, $18,883.65.

**Street Materials.**—At Louisville, Ky., contracts have been awarded as follows: Upick & Bronger, footways, $2.40 per ft.; M. Gleason, $2.70. Grainger & Co., 2 cts. and 4 cts. per lb. for cast and wrought-iron. J. R. Gleason, block stone, $2.75 per cu. yd. F. Gleason, flagstone and curbing, 34 cts. per ft. Geo. Hoertz, Jr., brick, $7.25 per 1,000 for sidewalks, and $6.25 and $6 for sewers and cisterns. C. B. Selvage, gravel, 30 cts. and 40 cts.

**Fire Brick Paving.**—The following are the prices of bids recently received by the City Council of Cumberland, Md.: H. Swartzwelder—To pave with Maxwell's Williams Station brick, $1.80 per sq. yd.; "New Cumberland" or "Wheeling" brick, $2; setting curbing, 50 cts. per lin. ft.

W. S. Fuller and P. M. Carroll—$2.70 per sq. yd. or $2.50 if the city removes cobbles; new curbing, 50 cts. per ft.: re-setting old curbing, 10 cts.

Matthew Corrigan—To furnish sand, tar and brick, $1.90 per sq. yd.; filling up old pavement and grading, 30 cts. per yd.; curbing, 50 cts. per ft.

W. J. Farrell—To furnish brick, paving and grading street, $1.35 per sq. yd.; new curbing 48 cts. per ft.; re-setting old curbing, 8 cts. per ft.

A. H. Amick—To remove cobbles, fill in and lay pavement, $1.75 per sq. yd.; or $1.55 if the city removes the cobbles and fills ready for the sand. If tar is used, add cost of tar and labor. New curbing, 55 cts. per ft.; re-setting old curbing, 10 cts. per ft.

U. S. Martin—To pave and remove cobbles, $2 per sq. yd.; if the city removes the cobbles, $1.84. New curbing, 48 cts. per ft. re-setting old, 8 cts. per ft.

**Pressure Regulators.**—J. M. FOSTER, of New York, has received an order for 7 more Foster pressure regulators for the Spiral Weld Tube Co., of East Orange, N. J., making 15 in all. The company is much pleased with the

arrangement of the regulators on the 10-in. machine. About 200 or 300 of these regulators will probably be needed altogether, as the plant is increased with new machines.

**The Westinghouse Engine.**—*The Woodchuck and the Wolf.*—A mechanical fable, founded on fact. A Yankee Woodchuck was in the hollow woodenware business in opposition to a Canadian Wolf. The Woodchuck imported Canadian lumber and exported butter bowls, underselling the Wolf in the Canadian market. Tiring of this, the Wolf sent a spy to the Woodchuck's factory and received a glowing account of the wonderful, fast, light-running machinery which whisked out a dozen bowls to the Canadian mill's one. After months of conservative deliberation, the Wolf, concluding not to be beaten, went down to the metropolis for a model plant. After learning much of the standard practice and finding what he supposed was needed, he purchased an outfit which turned out his product at a much reduced cost, but still the Woodchuck was underselling him in the Canadian market. After much thought, another visit to the Yankee mill not only revealed the fact that the Woodchuck had refitted with new machinery throughout, but that the Wolf had purchased the Woodchuck's second-hand plant. MORAL.—If you cannot afford to buy a Westinghouse compound engine, your competitors can.

**A Small Electric Light Dynamo.**—C. E. JONES & BRO., of Cincinnati, O., makers of models and experimental work, and dealers in telegraph and electrical supplies, will issue a circular concerning a small 18-light dynamo, showing the facilities offered by the firm for amateurs to make their own machines from the rough castings, which many of them are anxious to do. This dynamo has been designed and placed upon the market for use in mills, factories, stores, offices and other places where power is available and inexpensive, and where only a few incandescent lights are required; as a motor it develops nearly 2 H. P., with full current. The machine requires about 2 H. P. to drive it with its full capacity of 18 lamps and shows an electrical efficiency of about 82 per cent.; it requires about 1,900 to 2,200 revolutions per minute to develop its full capacity; weight complete, 200 lbs; floor space occupied, 20 x 40 ins. The circular contains a description of the machine, with cuts of the several parts, dimensions and details and price list. There are also full directions, with several illustrations, how to build one of these dynamos from castings and material furnished by the firm. The circular is most interesting to parties interested in electrical work, especially to those requiring a small dynamo, and also to amateurs.

**Government Work.**—*Rouses Point, N. Y.*—The following proposals for the construction of a breakwater were opened Oct. 18 by Major M. B. ADAMS, U. S. Engineer Office, Burlington, Vt.: Willard Johnson, Fulton, N. Y.; 7,625 ft. of rubble stone in work, 90 cts. per cu. yd., $6,862.50; 2,112 cu. yds. of large stone in work, $2.38 per cu. yd., $5,026.56; 73 lbs. of ring bolts in work, 10 cts. per lb., $7.30; total, $11,896.36. Nelson W. Fisk, Isle la Motte, Vt.; 85 cts., $6,481.25; $2.75, $5,808; 10 cts., $7.30; total, $12,296.55. The contract was awarded to Willard Johnson.

*Kanawha River, West Virginia.*—The following proposals for building 3 guard cribs at the head of Lock No. 2, Great Kanawha river improvement, were opened Oct. 11 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va.: Layten Williams, Malden, W. Va.; 80,000 ft. B. M. of timber and plank, $28 per 1,000 ft. B. M., $2,240; 1,400 cu. yds. of stone filling $1.40 per cu. yd., $1,900; 3,200 lbs. of drift bolts and spikes, 4 cts. per lb., $128; total, $4,328. John Morgan, Charleston, W. Va.; timber, $29.90, $2,392; filling, $1.45, $2,030; bolts, 2¾ cts., $88; total, $4,510. Keeney & White, Handley, W. Va.; timber, $33, $2,640; filling, $1.65, $2,310; bolts, 7 cts., $224; total, $5,174. Chas. F. Littlepage, Charleston, W. Va.; timber, $35, $2,800; filling, $1.75, $2,450; bolts, 7½ cts., $240, total, $5,490. The contract was awarded to Layten Williams, of Malden, W. Va.

*Delaware River, Pennsylvania.*—The following proposals for dikes were opened Oct. 15 by Lt. Col. HENRY M. ROBERT, U. S. Engineer Office, Philadelphia, Pa.: Stone dike between Fisher's Pt. and Petty's Id. John A. Bouker, New York City; stone $1.49 per cu. yd.; Brandywine Granite Co., Wilmington, Del., $1.45 for 10,000 cu. yds. of small, or $1.65 for 6,000 cu. yds. of large stone, average price $1.525; Davis B. Williams, Pickering, Pa., $1.89; S. B. & E. W. Twining, Yardley, Pa., $2.10; Joseph H. Ward, Ridley Park, Pa., $2.49. The contract was awarded to John A. Bouker.—Brush and stone dike near Reedy Id. E. H. Gaynor, Boston, Mass., $1.25 per cu. yd. for brush mattress, $1.30 per cu. yd. for stone, total $43,100; John A. Bouker, New York City, $1.69, $1.67, $57,250. The contract was awarded to E. H. Gaynor.—Pile and stone dike between Fisher's Pt. and Petty's Id, Davis & Irvin, Philadelphia, Pa.; Delaware pine piles, 15¼ cts. per lin. ft.; white oak piles, 27½ cts. per lin. ft.; pine wales and angle blocks, $37 per 1000 ft. B. M.; wrought-iron tie rods and screw bolts, with washers, 3¼ cts. per lb.; drift bolts, 3 cts. per lb.; stone filling, $1.35 per cu. yd.; total $8,521.63. Jos. A. Allen, Philadelphia, Pa.; pine and oak piles, 15½ and 25 cts.; pine wales and blocks, $38; bolts and rods, 4 cts.; stone, $1.65; total, $9,489.75. Brandywine Granite Co., Wilmington, Del.; piles, 23 and 37 cts.; wales, $47.25; bolts and rods, 6½ cts.; drift bolts, 4½ cts.; stone, $1.45; total, $11,074.60. Francis H. Smith, New York; piles, 32 and 43 cts.; wales, $57.20; bolts and rods, 5½ cts.; drift bolts, 5¾ cts.; stone, $2.49; total, $15,477.80. John A. Bouker, New York; piles, 17½ and 27½ cts.; wales, (no bid); bolts and rods, 4 cts.; drift bolts, 3½ cts. stone, $1.46; informal. The contract was awarded to Davis & Irvin.

*James River, Virginia.*—Contracts have been awarded as follows by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va. Alabama Dredging & Jetty Co., Mobile, Ala.; excavating 3,000 cu. yds. of solid rock and 3,000 cu. yds. of disintegrated rock, $6.33½ and $1.50 per cu. yd. American Dredging Co., Philadelphia, Pa., dredging 500,000 cu. yds. of sand and gravel, 16 cts. per cu. yd. John F. Gaynor, Fayetteville, N. Y.; 2,000 lin. ft. of mattress dike from Jetty 84 to 96, $2.47 per lin. ft.; 6,200 lin. ft. of mattress dike from Jetty B to 29, $1.75 per lin. ft.; 600 and 400 lin. ft. of jetty, $2.47 per lin. ft.

## Proposals Open.

**Water-Works.**—Complete system at Norwood Park, Ill. Surface reservoir, tower, tank, engine house, pump, boiler, pipe and pipe laying, hydrants, valves, connections, etc. Plans and specifications on file. E. B. SHERWIN, Village Clerk, Norwood Park, Ill. October 29.

**Railway.**—Grading and masonry for two additional tracks, on Pittsburg division; between Johnstown bridge and Sheridan, 1½ miles; between Turtle Creek station and Wilmerding, 1 mile; also change of line for three tracks east and west of Witmer, on Philadelphia division, 1½ miles. WM. H. BROWN, Chief Engineer, Pennsylvania R. R., Philadelphia, Pa. October 29.

**Street Work.**—Furnishing material; curbing, guttering and macadamizing. WM. C. HOLLIDAY, City Engineer, Clinton, Mo. October 30.

**Canal.**—St. Lawrence canals; constructing two locks and deepening and enlargement of the upper entrance of the Galops canal. A. P. BRADLEY, Secretary, Department of Railways & Canals, Ottawa, Canada. October 30.

**Pumping Machinery.**—Construction and erection of the proposed fourth set of pumping machinery. Plans and specifications on file. ROBT. SURTEES, Manager of Water-Works, Ottawa, Ont., Canada. October 31.

**Bridge.** — Iron bridge over the Passaic river at Clay St., Newark, N. J. Substructure and superstructure. Engineer, JAS. OWEN, 721 Broad St., Newark. THOS. W. KINSEY, Chairman of Joint Committee of Freeholders, County Court House, Jersey City, N. J. November 1.

**Street Material.**—Straight and circular curbing, curb corners, cross walk stone, granite blocks. S. M. GRAY, City Engineer, Providence, R. I. November 1.

**Water-Works.** — Complete system at Picton, Ont. Pumping station, reservoir, 4 miles of 4, 6 and 8-in. cast-iron pipe, specials, hydrants, valves, pumping engine, boiler, pipe laying, hose carts, hose, etc. Bids in lump sum. Plans and specifications at the office of the engineer. A. W. BRANSCOMBE, Chairman of Water Committee, Picton, Ont., Canada. November 2.

**Hydrants.**—Fifty fire hydrants. THE DISTRICT COMMISSIONERS, Washington, D. C. November 3.

**Water-Works.** Materials and construction. Plans and specifications by W. R. COATS on file. E. TEDFORD, City Clerk, Santa Ana, Cal. November 5.

**Bridge.**— Iron draw span, 75 ft. between masonry; wooden approach 226 ft. long. W. A. C. JONES, Livingston, Ala. November 6.

**Canal.**—Sault Ste. Marie canal. Date of opening bids postponed from Oct. 23. Plans and specifications on file. A. P. BRADLEY, Secretary, Department of Railways & Canals, Ottawa, Canada. November 11.

**Water-Works.**—Complete system at Sprague, Wash. Ty. Plans on file. W. B. LOTTMAN, City Clerk, Sprague, Wash. Ty. November 19.

**Sewers.**—In District No. 8, 5th Ward. Plans and specifications on file. Constructing Engineer, WM. H. LANDRETH, of Schenectady. H. B. WALDRON, Secretary of Sewer Commissioners, Amsterdam, N. Y. November 20.

GOVERNMENT WORK.

**Dredging and Breakwater.** — Dredging at Grand Marais, Minn. October 29.—Dredging in Superior bay and St. Louis bay, Wis. October 29.—Breakwater at Agate bay, Minn.; 150 ft., foundation of rip-rap and crib-work of timber filled with stone. November 1.—Dredging in harbor at Duluth, Minn. November 13.—Major JAMES B. QUINN, U. S. Engineer Office, Duluth, Minn.

**Dredging; Stone and Brush.**—Dredging 20,000 cu. yds. at Plymouth, Mass. November 1.— Stone and brush for beach protection at Long Point, Provincetown harbor, Mass. November 2.—Lt. Col. G. L. GILLESPIE, U. S. Engineer Office, Boston, Mass.

**Dredging.**—Dredging channel connecting Assowam bay with Indian River bay, Del. November 2.—Dredging in Duck creek, Del.; Choptank river, Md.; and Cambridge harbor, Md. November 10.—WM. F. SMITH, U. S. Engineer Office, Wilmington, Del.

**Sewerage.**—Complete and modern system, with water closets, bath tubs, buildings, etc. Lt. E. B. PRATT, Asst. Q. M., U. S. A., Fort Mackinac, Mich. November 5.

**Pier.**—In front of Fort Brady at St. Mary's Falls canal, Michigan. Col. O. M. POE, U. S. Engineer Office, Detroit, Mich. November 19.

## Bridges and Canals.

**Bridge Notes.**—*Providence, R. I.*—The Park Committee will build a bridge in Roger Williams Park at a cost of $17,000. Plans have been prepared by the City Engineer.—The Bridge Committee has been granted $6,500 for replacing the Dexaine St. bridge over the Woonasquatucket river with an iron structure.

*Cincinnati, O.*—Work is progressing on the center span of the Ohio river bridge, and will soon be as far advanced as at the time of the wreck.

*Riverton, Va.*—The Shenandoah Valley R. R. Co. is building an iron bridge over the Shenandoah river; there will be 6 spans; total length of bridge and approaches 1,500 ft. Estimated cost, $30,000.

*Memphis, Tenn.*—Work has been commenced on the foundations for the new railroad bridge over the Mississippi.

*Rome, Ga.*—The 5th Ave. county bridge across the Oostanaula river has been completed.

*Kansas City, Mo.*—The Kansas City & Randolph Bridge Co., which proposes to build a pontoon bridge across the river, has increased its capital stock to $150,000.

*La Crosse, Wis.*—A highway bridge across the Mississippi is projected; the total cost of bridge and approaches would be about $150,000 to $175,000. A subsidy of $50,000 has been voted towards the enterprise.

*Laredo, Tex.*—The new iron bridge of the Mexican National Ry., across the Rio Grande, has been completed.

*Asheville, N. C.*—It is reported that the County Commissioners will spend about $10,000 on new bridges.

**Rideau Canal.**—The forwarders on the Rideau canal and residents in towns and villages along the route of the canal from Ottawa to Kingston are preparing a memorial to the Dominion Government asking that the channel of the Rideau be deepened one foot. They complain that business along the route is becoming destroyed by the gradual filling up of the channel, rendering it impossible for boats to pass up and down.

**Suspension Bridge.**—One of the two cables for the suspension bridge at Oregon City, Ore., has been delivered; it is composed of 7 steel cables, each 1⅞ ins. diameter. The bridge from anchorage to anchorage will be 800 ft. long and 77 ft. above the surface of the water. The towers will be 90 ft. high, and upon these work is now going forward.

**Viaduct.**—It is understood that there is an organized effort on the part of the village of Hyde Park, Ill., the town of Lake, and the representatives of the Lake Shore & Michigan Southern and the Pennsylvania railroads and the Chicago City Railway Co., to bring about by an equitable arrangement the building of a large and substantial iron or steel viaduct over the area of tracks at 63rd and State Sts.

**Hawk St. Viaduct.**—The survey for the Hawk St. viaduct at Albany, N. Y., has been completed. The floor will be 70 ft. above Canal St. and the grade will be about 4 per cent. Plans have been submitted to the Viaduct Commissioners. PALMER C. RICKETTS, of Troy, N. Y., is the engineer for the commissioners. The plans will be considered Oct. 29.

**The Central Viaduct at Cleveland, O.**—The draw span over the river is completed, work is progressing on the other parts and the structure is expected to be completed in November. The tracks of the New York, Chicago & St. Louis Ry. will be crossed by a cantilever span. The contractors for paving and planking are following up the men who are putting up the iron work. The contractors for building the hand railings and the sidewalks are also following up the other workmen closely. The street railway tracks will also be put down as the work goes on. This systematic method of carrying forward the undertaking will leave very little to be done when the iron work is completed. The following are the principal dimensions:

*Cuyahoga Valley Portion.*

Length of floor, 2,833 ft. 6 ins.
Height above city base of levels at river, 99 ft. 2 ins.
Height above river, ordinary stage, 101 ft.
Height above N. Y., C. & St. L. Ry. tracts, 33 ft.
Length of draw span (floor), 239 ft.
Width of roadway, 40 ft.
Width of sidewalks, 8 ft.
Grade, 0.3 per 100.

*Walworth Run Portion,*

Length of floor, 1,092 ft. 6 ins.
Height above city base of levels at N. Y., C. & St. L. Ry., 105 ft, 6 ins.
Height above N. Y., C. & St. L. Ry. tracks, 35 ft.
Height above Scranton Ave., 76 ft. 6 ins.
Height above C., C., C. & I. Ry. tracks, 68 ft. 6 ins.
Width of roadway, 49 ft.
Width of sidewalks, 8 ft.
Grade, 5 ft. per 100.
Distance from intersection of Ohio and Harrison St. to Abbey St. abutment, 5,425 ft.

**Montreal Harbor Commissioners**—The Harbor Commissioners of Montreal, Canada, in their report for 1887, refer to the deepening of the ship channel between Mon-

treal and Quebec, which work has been in progress since 1873, when there was a depth of only 20 ft. of water; in 1883 there was a minimum depth of 25 ft., and there is now a depth of 27½ ft. for a considerable distance. For this work money has been loaned by the Dominion Government to the amount of $2,680,000, the yearly charge for interest on which is a continual burden on the revenues of the harbor, preventing any substantial improvements or extensions in the harbor, and as such improvements are needed, the Minister of Public Works has been petitioned to relieve the Commissioners of the payment of this interest, especially as the work is not of a local character, but of general importance, for which reason the cost of the same should be borne by the Government. The reports of JOHN KENNEDY, Chief Engineer, describe the proposed improvements, and also give the details of work performed during the year, both in the harbor and in the main ship channel. The average cost of dredging in 1887, with spoon dredges and stone lifters, was 62 cts. per cu. yd. Tables show the class of dredging plant employed, and the work done by each dredge.

## WATER.

**The Nutting Electric Mfg. Co.**, of Chicago, Ill., has been incorporated by SAML. E. NUTTING, W. H. FOULKE and J. W. HEFENBURG, with a capital stock of $100,000 to manufacture electric apparatus.

**Natural Gas.** — At Sparta, Ill., the City Council has passed an ordinance allowing the Sparta Natural Gas Co. to lay its mains through the city. The franchise is for 20 years, the city is to be furnished with 30 lights for one year, and the basis of charge for fuel is to be the cost of coal at 5 cts. per bushel. JAS. E. GASTON is in charge of the work. The company which bored 1,100 ft. for gas and abandoned the well on account of the salt water met with, will sink another well near the center of the town.

**Drainage in Missouri.** — The County Surveyor at St. Charles, Mo., will spend considerable time this autumn or winter in the Vermillion drainage districts of Illinois to study the drainage problem, as there are thousands of acres of land in St. Charles county needing drainage.

**Water Power.** — The Arkansas River Water Power & Mfg. Co. has been incorporated by B. F. PARKER, of Independence, Mo.; J. S. FALIN, of Kansas City; M. B. PARKER and R. A. WILLIAMS, of Olathe, Kan.; and D. PIATT and S. D. PIATT, of Topeka. The company will operate in Oxford township, Sumner Co. Capital stock, $50,000.

**The Sierra Water Co.** has been incorporated at San Francisco, with a capital stock of $2,000,000. The Directors are H. WARD, F.E. GLADRIM, W. GRUENHAGEN, F.W. MACOUDRAY and JOS. G. KEARNEY. It is the purpose of the company to acquire and develop water rights and sell water for mining, irrigating and domestic purposes.

**Curtis, Neb.** — The Lincoln Land Co. is establishing a lake for water power. Weld cañon opens into the valley of the Medicine, just southwest of the village, and, as the valley is quite low, the grade is consequently very high. A canal is now being cut which turns the water of the Medicine into this cañon, and a lake will thereby be formed which will cover about 100 acres. A dam will be put in, and a mill to be operated by water power will be built by Ranney & Frank, of Blue Hill.

**Sewers.**—***Northampton, Mass.***—Mr. BOWDITCH, C. E., of Boston, has submitted to the Sewer Commissioners his plans, which include a system of large pipes for surface drainage and small pipes for house drainage, the intention being to incorporate the present sewers into the new plans as far as possible. An appropriation for $20,000 is to be applied to this work.

***Springfield, O.***—The Committee on Public Improvements has reported in favor of a system of sewers on the Waring plan, utilizing the present sewers for the surface waters.

***Wichita, Kan.***—Work on the sewerage system has been commenced.

***Santa Rosa, Cal.***—Plans for a proposed system of sewerage have been prepared by F. T. NEWBERRY.

***Oldtown, Me.***—A system of sewers is projected, in view of the expected growth of the city when the new Canadian Pacific line is in operation.

***Fort Collins, Col.***—Pipe sewers and tile drains are being laid.

**Water Power.**—The White Iron Lake Iron & Water Co. has been incorporated at Duluth, Minn., to furnish power to mining companies about Ely and adjoining districts, on the Vermilion range. The power will be used for compressing air for use in the mines. A dam will be built at the falls in White Iron lake. The company is composed of HENRY H. BELL, EDGAR BROWN, F. W. EATON, RICHARD FAGAN, of Duluth; DAVID S. FOX and CHARLES S. BROWN, of Flint, Mich.; HENRY M. LOUD, Oscoda, Mich., and GEORGE L. WALKER, of Detroit, Mich. The capital stock is $1,000,000.

**Oakland, Cal.**—The Park Place Water Co. has been incorporated to develop water supplies for domestic and irrigation purposes. Capital stock, $250,000. Directors; J. H. WOODARD, W. E. HALE, W. B. KING, F. A. LEACH and B. NOYES.

**The Parker Automatic Water Gate Co.** has been incorporated at Menominee, Wis., by GEO. H. BARWISE, JOHN H. KNAPP, Jr., JOHN HAPGOOD and ELMER J. NEWTON. Capital stock, $10,000.

**Dam.**—J. B. GALLAGHER is building a dam at the outlet of the Twin Lakes in western Nevada. The dam will be 125 ft. long, and 15 ft. high; it will create a storage reservoir, 6 miles long and 5 miles wide, with over 80 ft. depth of water, that can be drawn off by means of a short tunnel.

**Tile Draining in Illinois.**—The *Prairie Farmer* compiles from the statistical report of the Secretary of the State Board of Agriculture, a table showing the length of the drains laid in the different counties of the State, and gives the grand aggregate of the whole as 365,466,830 ft., or 68,939 miles. Illinois has about 9,000 miles of railroad, so that according to the above figures, for every mile of rails on the surface there are 7 miles of pipe under ground.

**Artesian Wells Increase the Value of Land.**—The *Clipper*, of Fremont, Neb., says: "Charley George, of Laramie, had an artesian well sunk on a lot of land in the suburbs of town. The land before the well was sunk was probably worth $2,000. Since the sinking of the well he has sold the same for $12,000. This would be rating the well at about $10,000. It cost less than $200 to sink the well. A snug little profit on a hole in the ground."

**Braddock, Pa.** — A new gas company has been organized at Braddock, which proposes to furnish the citizens of that place with cheaper fuel and light than they are obtaining now. The gas will be made by a new process.

**Fostoria, O.**—After exhaustive and expensive experiments with deep wells and shafts in solid limestone, Ferris & Halladay, of Jersey City, N. J., have withdrawn their proposition to erect water-works, as they failed to find a water supply adequate in quantity and quality. Their experimental work demonstrated the folly of entering upon construction and they therefore surrendered the franchise, for the reason above given.

**Pomona, Cal.**—A complete system of sanitary drainage is recommended and the enterprise has been favorably reported to the City Council by JAMES T. TAYLOR, City Engineer of Pomona, and A. H. KOEBIG, City Engineer of San Bernardino. Their report recommends the separate system, the sewage being disposed of by being discharged on a suitably arranged sewage disposal farm. The sewers will be of salt glazed earthenware pipe; 18 and 20 ins. for the main pipe, 12 and 14 ins. for the receiving pipe, and 6 and 10-in. for laterals. The main and receiving sewers have been designed large enough for a population of 30,000, in order to provide for the growth of the city. The preliminary estimate of cost is as follows:

| | |
|---|---|
| Sewage farm of 80 acres (sufficient for 8,000 people) | $ 2,000 |
| Drain system for sewage farm | 12,000 |
| Two miles of main sewer | 29,800 |
| One mile of receiving sewer | 7,000 |
| Seventeen miles of lateral sewers | 81,000 |
| Total | $141,800 |

**New London, Conn.** — The Board of Water Commissioners submitted its seventeenth annual report at the annual city meeting in September, 1888. The total receipts for water rates amounted to $23,575.01, an increase of $463.72. The cost of maintenance was much larger than usual; the principal items of increase were thawing and repairing 85 service pipes at an average of $8.34 each, repairing mains damaged or destroyed by lightning (this damage was confined to the cement lined pipe), and lowering the Pequot Ave. main. The condition of the lake and the quality of the Konomoc water has been satisfactory, except for a slight unpleasant taste of the water for a few days in June. The board recommends the establishment of an increased supply, and two plans are suggested: (1) a new 20-in. iron main, $100,327; (2) a reservoir or tank and motor, $8,975. The pipe extensions amounted to only 2,392 ft. There were on Sept. 1, 15,441 ft. of cast-iron pipe, 6,823 ft. of clay pipe (conduit), 116,413 ft. of wrought-iron cement-lined pipe, a total of 138,677 ft.; 34,307.8 ft. of service pipe, 137 hydrants, 130 gates. Total estimated consumption, 490,000,000 galls. W. H. RICHARDS is Superintendent and Engineer.

**Water Works.**—***Rhode Island.***—Phenix. The trenching and pipe laying for the extension of the public water works is progressing and about 22,000 ft. of pipe are already laid. H. B. Leach, the contractor, estimates that the work will be completed in December.

***New York.***—Albany. The upper reservoirs of the new system, near West Albany, will not be finished until next season, but they will be far enough advanced to allow of water being supplied from them by Dec. 1.——Williamstown. The pipe laying is nearly completed.——Castile. Water-works are projected. Address M. AYRAULT.

***Pennsylvania.***—Everett.—A water company has been incorporated by WM. A. CONNELLY and others; capital stock, $10,000.——Philadelphia. Water was turned into the second completed section of the East Park reservoir on Oct. 23; the basin has a capacity of 310,000,000 galls.——Reynoldsville. Water-works are to be built at a cost of $12,000. Address N. COOPER.

***District of Columbia.***—Washington. The District Commissioners are laying a main to increase the supply in South Washington, at a cost of $30,000.

***Kentucky.***—Covington. The weather is delaying progress on the new water-works. The pipes will all be laid by Nov. 15, and the pumping plant will be in position before the reservoirs are completed. Water will not be turned on before July.

***South Carolina.***—Greenville. The Jeter & Boardman Gas & Water-Works Association, of Macon, Ga., has made a proposition to build water-works at a cost of about $150,000; the works to be owned by the company and the city to take not less than 50 hydrants at $60 per annum each.

***Alabama.***—Tuscumbia. A bill is proposed to authorize the issue of bonds for water-works.— Mobile. The Bienville Water Supply Co. is placing its hydrants.

***Indiana.***—Franklin. The city has awarded to Comegys & Lewis, of New York, a contract for water-works, with 7 miles of mains, to cost $60,000.

***Illinois.***—Peoria. The efficiency of the city water works for fire purposes has been increased by connecting the two 10-in. pumps at one of the distilleries with the pipe system for use in emergency. This will increase the pipe pressure in the neighborhood of the distilleries and elevators from 120 lbs. to 160 lbs.

***Iowa.***—Clinton. The Clinton Water-Works Co. has transferred its stock to the American Water-Works & Guarantee Co., of Pittsburg, Pa.

***Missouri.***—Washington. The fire plugs for the water-works have arrived, and are being distributed. The company has commenced to concrete and cement its clear-water basin, and the embankments for the reservoirs have been finished; they are 12 ft. high, and required 2,000 yds. of dirt to build them. Work is progressing on the steel stand-pipe.

***Kansas.***—Smith Center. The city will put in a system of water-works soon. Address A. S. KINGSBURY, City Clerk.

***Nebraska.***—Broken Bow. The Broken Bow Water-Works Co. has been incorporated by S. J. LONERGAN, O. J. COLLMAN, D. M. AMSBERRY, MARCUS KEYNER, JOHN REESE, I. A. HOLCOMB, L. H. JEWETT, JAMES HOLLAND, A. W. GAUDY, WILSON HEWITT, G. N. RAMSON and GEO. W. STURTEVANT.

***California.***— Thermalito Colony, Butte Co. Nine miles of water pipe have been laid this year.——Pomona. A water company has been incorporated with a capital stock of $250,000.——Woodland. The Woodland Water-Works Co. has put in a new pump with a daily capacity of 1,500,000 galls., in addition to two others now in use having a capacity of 44,000 galls. an hour. Woodland has now two systems of water-works, there having formerly been two companies, between which there existed strong competition, but which are now amalgamated into one corporation.

***Arizona.***—Phœnix. The city has granted 2 franchises for water-works. One system is already under construction by J. J. GARDNER, on the direct pumping system, and the other is to be immediately begun by the Arizona Improvement Co., which will take water from the Arizona canal and conduct it in large mains to the city under a high pressure by gravity.

***Texas.***—Temple. A citizens committee recently interviewed General Manager SCOTT, of the Santa Fé system, to ascertain what assistance the company will render in extending and improving the water supply, as the company requires a water supply at this point of about 70,000 galls. per day. Hitherto the city has secured its water supply from a system of wells as the supply source. This supply being found inadequate to meet the increased and growing demand, the water-works company has decided to increase its plant by running a line of pipe to the Leon river, a distance of about 7 miles, and drawing its water supply from that source in the future. This will entail an additional expense of about $45,000.

**Lincoln, Neb.**—A proposition was recently made by Joseph Burns to supply the city with good, fresh water for the term of 20 years, furnishing the water and all machinery, material and labor necessary to deliver the water in the city mains; the city paying for the same in the following manner, viz: The city agreeing to take at least 1,500,000 galls. of water per day, at the rate of 7 cts. per 1,000 galls. for the first 1,500,000 galls. and 6 cts. per 1,000 for the next 1,000,000 galls. above that amount per day.——Apparently, however, the new wells at the Antelope river will furnish a sufficient supply, as the pump has been drawing 250,000 galls. per day from them. The water reaches to within 3 ft. 8 ins. of the surface of the ground. Water Commissioner J. L. LYMAN has reported, under date of Oct. 8, that he is satisfied with the test of this source, and recommends that a large well 20 ft. diameter be put down to the sandstone formation. The wells recently put down are 10 in number, 17 ft. deep to the first water bearing gravel. A well to test the formation showed the following strata: Soil, 7 ft.; blue clay, 5 ft.; quicksand, 2 ft.; gravel, 4 ft.; red clay, 6 ft.; water bearing gravel, 8 ft.; blue clay, 5 ft.; yellow sand and gravel, 5 ft. Total, 42 ft. This well flowed 60,000 galls. per day. The cost of the work, if done by contract is esti-

mated at $11,000, or $12,000 to $13,000 if done by day labor, and the minority of the special committee considered this too much, and recommended that a supply be sought for outside the city, at Oak creek or Salt creek bottoms,

**Milford, N. H.**—A report on the water supplies in the vicinity of Milford has been made to the Selectmen of that place by HENRY A. HANCOX, C. E. The report deals generally with the advantages of a water supply system, describes the three modes of supply—by gravity, by pumping to reservoir, and by direct pumping,—and points out the fact that smaller towns than Milford have invested in public water-works and made the investment a financial success. Statistics gathered from annual reports from certain towns show that in the first year after the works go into operation 40 per cent. of the inhabitants are water takers, and after 3 years from two-thirds to three-fourths. The different sources of supply are mentioned and the Clark brook is recommended for a pumping system, with a large collecting well. The water is wholesome and the supply ample. It is proposed to put in a duplex compound pumping engine with a daily capacity of 1,000,000 galls. and pump the water to an iron stand-pipe, 30 ft. diameter and 48 ft. high, with a capacity of 250,000 galls. A pumping supply from the Quinlan springs is also considered and analyses of the water from these two sources, as well as estimates of cost of the works, are given. The Clark brook system is estimated to include 5.38 miles of 4 to 12-in. pipe, 20 tons of specials, 40 hydrants, 61 gates, well, pumping plant, stand-pipe, etc., and the total cost, $56,068.65. The Quinlan springs system is estimated to include 5.73 miles of pipe, other plant as above, and to cost $57,233.44, not including the value of the springs.

**Delaware, O.**—A water-works franchise, passed Oct. 4, has been granted to Moffett, Hodgkins & Clarke, of Watertown, N. Y. The supply is to be drawn from wells sunk in the gravel, and protected from the infiltration of surface or river water; the number of wells will be increased as occasion demands. A connection will be made with the river for use in cases of emergency. The pumping plant will be located in a masonry pumping station and will consist of two independent, compound, duplex engines with a daily capacity each of 2,000,000 galls. against a pressure equivalent to 300 ft. head, at a piston speed not exceeding 100 ft. per minute; there will be 2 steel, return tubular boilers, 5 ft. diameter, 16 ft. long. There will be a metal stand-pipe, 20 ft. diameter and 100 ft. high located on high ground. Direct pressure for fire purposes. There are to be not less than 16½ miles of pipe, including the pumping main, within the corporation limits; the pipe will be 4 to 16 ins. diameter, of cast-iron (except at river crossings where wrought-iron may be used. The pipe to be laid at least 4 ft. from surface of ground to top of pipe. Double nozzle, frost proof hydrants will be used. At the test, streams are to be thrown to a height of 100 ft. and a distance of 132 ft. The franchise is for 20 years, and the city will pay $7,800 per annum for water for 206 hydrants. The city may purchase the works at the end of 10 years. Surveys and levels have been made by Mr. MINOR, C. E., and test wells drilled at different sites by James Holly, of Delaware.

**Electric Light.**—***Cohoes, N. Y.*** — The Street Lighting Committee has been directed to make a contract with the Cohoes Electric Light Co. to furnish 100 lights for one year at 30 cts. per lamp per night.

***Burlington, N. J.***—An ordinance has been passed for electric street lamps to supersede the present oil lamps.

***Beaver Falls, Pa.*** — Beaver Falls, New Brighton, Rochester and Bridgewater are to be supplied with the electric light by a stock company.

***Alton, Ill.*** — The Alton Electric Light & Gas Co. has been incorporated by A. E. CAMPELL, JOHN WATT and LEVI DAVIS, Jr. Capital stock, $60,000.

***Eau Claire, Wis.***—An electric light company has been organized; President, H. H. HAYDEN; Vice-President, F. GILBERT; Secretary, R. E. RUST: Electrician, WALTER K. FREEMAN.

***Duluth, Minn.*** —The Duluth Electric Co. will put in a plant with a capacity for 100 incandescent lights and 150 arc lights. President, O. C. HARTMAN; Secretary, C. E. VAN BURGER.

***Galveston, Tex.***— A committee has been appointed to investigate as to the establishment of an electric light plant, and to advertise for bids for lighting the city.

**Gas Works.**—***Jamaica, N. Y.***—The Jamaica Gas Light Co. is extending its mains. Chas. E. Twombly has the contract for trenching.

***Islip, N. Y.***—The Suffolk Mutual Gas Co. is making rapid progress with its works and pipe laying.

***New Albany, Ind.***—The New Albany Gas Light & Coke Co. has awarded to the Kerr, Murray Co., of Fort Wayne, a contract for new plant, to be erected in the new buildings. The improvements will cost $30,000, which with the $30,000 for pipe extensions already made, will make $50,000 expended by the company this year.

***Tallapoosa, Ga.***—The gas works were burned Oct. 17, involving a loss of $12,000.

***Gainesville, Tex.***—The Gainesville Gas & Coal Co. has increased its capital stock from $50,000 to $80,000.

***Tucson, Ariz.***—Gas works are wanted, and steps will be taken to establish a plant.

## Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water-Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

DERRY STATION, Pa., Oct. 16, 1888.

EDITOR ENGINEERING NEWS: The Irwin Water Co. proposes to build a system of water-works, beginning in the spring of '89 and finishing about Sept. 1 of the same year. The works will be an extension of those now being built at Greensburg, our supply coming from their mains by gravity. There will be a reservoir just outside the town. Contracts have been let to the Pennsylvania Mfg. Co., of Germantown, F. Z. THELLENBERG is President of the company, and C. W. KNIGHT, Rome, N. Y., Engineer. M. FORBES.

SPOKANE FALLS, Wash. Ter., Oct. 18, 1888.

EDITOR ENGINEERING NEWS: Our water-works are to be extended at once, the contract having been let Oct. 7 to Philip Behner, of Portland, Ore. R. A. JONES is Engineer. We shall advertise for tenders for $70,000 of bonds, running from 10 to 20 years, with interest at 7 or 8 per cent., payable semi-annually.

SIDNEY D. WATER,
*Chairman Water Board.*

We have received from Mr. ISAAC S. CASSIN, of Philadelphia, under date of Oct. 22, descriptive reports of water-works now in progress at Bound Brook, N. J., and Newark, Del., which we give below: Mr. CASSIN is the engineer for each of these works.

***Bound Brook, N. J.***—The works are being built by the Bound Brook Water Co., which is incorporated under the State laws and has a perpetual charter. Work was begun Sept. 1, and will be finished in the spring of 1889. The supply is taken from Middle Brook, a stream 2½ miles northwest of the town. There are two dams forming storage reservoirs, the first dam forming a reservoir with a capacity of 3,000,000 galls., and the second one with a capacity of 15,000,000 galls. The first serves as a distributing reservoir. L. J. WRIGHT, of Newton, Conn., is contractor for the dams. There will be 5 miles of 12 to 4-in. cast-iron mains, and the service pipe will be of lead and wrought-iron. The pipe is furnished by the Donaldson Iron Co., of Emaus, Pa., and the trenching and pipe laying will be done by Oppermann & Hillpot, of Harrisburg and Philadelphia, Pa. There will be no meters, and the number of hydrants has not yet been decided, but specials, valves and hydrants will be furnished by the Union Hydraulic Works, Philadelphia, Pa. The pressure will be 45 lbs. The officers of the company are: President, JAS. M. THOMPSON; Secretary and Treasurer, W. B. R. MASON; Superintendent and Manager, SYLVANUS, AYRES, Jr.

***Newark, Del.***—The works are being built by the town, under direction of its Council. Work was begun in July, and will be finished in Dec., 1888. Water is taken from a well 20 ft. in diameter and 35 ft. deep, by direct pumping and pumping to stand-pipe. There are two compound duplex pumps, each having a daily capacity of 500,000 galls., furnished by the Holly Mfg. Co., of Lockport, N. Y. There are also two boilers, 4½ by 12 ft. The stand-pipe is 25 ft. in diameter, 50 ft. high, placed on an elevation of 80 ft. It is furnished by Basshor & Co., of Baltimore, Md. There are 3½ miles of 10 to 6-in. cast-iron mains, and the service pipes are of lead, galvanized and wrought-iron. The pipe and specials are furnished by McNeal Pipe & Foundry Co., of Burlington, N. J. The contractor for trenching, pipe laying and buildings is Jos. Hyde, Wilmington, Del. Masonry and foundationss and all other work, is done by the town. There will be no meters, and the valves and hydrants are furnished by the Union Hydraulic Works, Philadelphia, Pa. The works will cost $35,000, and there will be a bonded debt of $30,000 at 5 per cent. interest. There are 40 hydrants, and the pressure will be, ordinary, 40 lbs.; fire, 125 lbs. The Superintendent has not been appointed.

MONONGAHELA CITY, Pa., Oct. 22, 1888.

EDITOR ENGINEERING NEWS:—In August last the Monongahela City Water Co. put down 2,000 ft. of 8-in. main pipe, purchased a reservoir site for $1,000, and a pumping station site for $500. On account of a flood, and so much rain this fall, they will not finish the works until next spring. Water is to be pumped to a reservoir from Monongahela river. ROBT. H. WILSON, is engineer. Population, 4,000. T. H. WILLIAMS.

TAZEWELL C. H., Va., Oct. 20, 1888.

EDITOR ENGINEERING NEWS:—Tazewell Court House Va., is the county seat of the county of the same name. It is an enterprising town of about 900 inhabitants, situated near the head waters of Clinch river, about 1¼ miles north of the station of the same name on the Clinch Valley division of the Norfolk & Western Railroad. Water is obtained from a spring located about 1¼ miles north of the town at an elevation of 320 ft. above the main street, opposite the Court House. From the spring the water is conducted through a 2 in. pipe, 2,475 ft. in length, to a circular reservoir having a diameter of 26 ft. at top, 22 ft. at bottom and a depth of 11 ft. It is of stone masonry, and its capacity is about 35,000 galls. at an elevation of 170 ft. above the town. This reservoir was built by D. H. PHIPPS of Tazewell C. H., and cost $780. From the reservoir the water is conducted to the town through a 4-in. cast-iron main 6,800 ft. long, which includes that portion laid in Main Street, the only street having water pipe.

The water main was furnished by the Glamorgan Co., of Lynchburg, Va., and was laid under the direction of Jas. Allen of the same place.

The contractors for the trenching were Messrs. W. S. Brown and Geo. Voss, both of Tazewell, C. H. There are 7 fire hydrants, being Galvin's compound wedge, made at Detroit, Mich. In addition, there are 5 public service hydrants located in the streets for the benefit of consumers. These were made by Jarecki, Hays & Co., of Erie, Pa. There are only about eleven house services, the pipe being ¾-in. galvanized iron, and the daily consumption does not probably exceed 10,000 galls.

The cost of the works has been about $4,500 and the annual revenue does not quite reach $400. The annual operating expenses are $75, which is merely the salary paid to the Superintendent, G. L. MCCLINTOCK.

EMILE LOW.

In addition to the above from M. FORBES of Derry Station, Pa., he sends under date of Oct. 22, some items regarding the Westmoreland Water-Works Co.'s system at Greensburg, Pa., of which the works for Irwin are an extension. The Westmoreland Co. takes its supply from streams in Chestnut ridge, by gravity, at an estimated cost of $300,000. GEO. T. HUFF is President of the company, and C. W. KNIGHT, Rome, N. Y., its engineer. The general contractor is the Pennsylvania Pipe Mfg. Co., Germantown Junction, Pa. Water will be supplied Dec. 1. The population is 6,500. M. FORBES can give further information.

## RECORD OF NEW WATER-WORKS CONSTRUCTION.

*(Specially communicated).*

CONTINUED FROM PAGE 318.

*Minneapolis, Kan.*—The works were commenced in April, 1887, and completed July 1, 1887. They were designed by B. R. CLARKE, and the Constructing Engineer was J. T. TALBOT. The contractors were Turner, Clarke & Rawson, of Boston, Mass. the pumping machinery was supplied by the Geo. F. Blake Mfg. Co., of Boston; the pipe and specials by the Gloucester Iron Works, of Philadelphia, Pa., and the valves and hydrants by the Ludlow Valve Co., of Troy, N. Y. The supply is taken from 2 wells in brown sandstone, connected by a tunnel and reinforced by driven wells. The water is pumped direct by two duplex engines, one simple and one compound, with a daily capacity of 1,750,000 galls.; steam is supplied by two 60 H. P. return tubular boilers. There are 4¼ miles of pipe, 51 hydrants, 200 taps and 22 meters; the mains are of cast-iron, and the services of galvanized iron. Average daily consumption, 40,000 galls. Ordinary pressure, 60 lbs.; fire pressure, 100 lbs. The main well is about 40 ft. deep (24 ft. below engine room floor) and the working shaft 44 ft. deep; at the bottom of the first there are four 5-in. drilled wells, and at the bottom of the other. four 6-in. drilled wells. They are about 70 ft. apart, and the tunnel, which is 6 ft. by 6 ft. extends beyond the main well, its total length being 94 ft. The depth of water in the pump well is 13 ft. and its temperature is 60° F. The franchise is for 20 years: the hydrant rental is $2,745 per annum for 51 hydrants, or $45 each. The works are owned by the Minneapolis Water Co.: President, A. B. TURNER; Treasurer, J. WENTWORTH BROWN; Secretary, A. GILBERT; capital stock, $100,000. E. O. DAVIS is Superintendent. The present population is $3,600. (Date of special report; May 15, 1888).

*Brookfield, Mass.*—The works were commenced in November, 1887, and completed in July, 1888. At the date of our special report (June, 1888), the pipe was laid and the reservoir nearly completed. They were designed by A. C. MOORE; who was also Constructing Engineer. The contractors for masonry, foundations, trenching and pipe laying were Neil McBride, of Boston, and Thos. G. Hennessey. The materials, pipe, specials, valves, hydrants, etc., were purchased by the Water-Works Committee. The water is supplied by gravity from springs, and the reservoir has an area of ¾ acres. There are 9,500 ft. of 6, 8, 10 and 12-in. iron pipe, and 10 hydrants. Cost of works, $16,000; debt, $16,000; rate of interest, 4½ per cent. The works are owned by the town. Population, 3,000.